

**CPC****COOPERATIVE PATENT CLASSIFICATION****H01S****DEVICES USING STIMULATED EMISSION****NOTE**

This subclass covers:

devices for the generation or amplification, by using stimulated emission, of coherent electromagnetic waves or other forms of wave energy;

such functions as modulating, demodulating, controlling, or stabilising such waves.

**WARNING**

The following IPC groups are not used in the CPC scheme.

Subject matter covered by these groups is classified in the following CPC groups:

- [H01S 3/098](#) covered by [H01S 3/08 M](#), [H01S 3/11](#) and s.gr.

**H01S 1/00**

**Lasers, i.e. devices for generation, amplification, modulation, demodulation, or frequency-changing, using stimulated emission, of electromagnetic waves of wavelength longer than that of infra-red waves**

**H01S 1/005**

- { using a relativistic beam of charged particles, e.g. electron cyclotron maser, gyrotron }

**H01S 1/02**

- solid

**H01S 1/04**

- liquid

**H01S 1/06**

- gaseous, { i.e. beam masers ( 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 for generation, amplification, modulation, demodulation, or frequency-changing, using stimulated emission, of infra-red, visible, or ultra-violet waves ( { stimulated Brillouin or Raman effects [H01S 3/30](#) } ; semiconductor lasers [H01S 5/00](#) )**

**H01S 3/0007**

- { Applications not otherwise provided for ( working metals or other materials by laser beam [B23K 26/00](#) ; using photons to produce a reactive propulsive thrust [F03H 3/00](#) ; optical recording of measured values in general [G01D 15/14](#) ; optics in general [G02B](#) ; holographic processes or apparatus [G03H](#) ; optical marking or sensing of data record carriers [G06K 7/10](#) to [G06K 7/14](#) , [G06K 15/12](#) ; injection heating of plasma by laser [H05H 1/22](#) ; acceleration of neutral particles by electromagnetic wave pressure [H05H 3/04](#) ) }

**H01S 3/0014**

- { Monitoring arrangements not otherwise provided for ( photometry [G01J 1/00](#) , e.g. [G01J 1/4257](#) ; radiation pyrometry [G01J 5/00](#) ; measuring coherence of light [G01J 9/00](#) ; measuring wavelength of light [G01J 9/00](#) , e.g. [G01J 9/0246](#) ; measuring optical pulses [G01J 11/00](#) ; calorimetrically measuring power of laser beams [G01K 17/003](#) ) }

- H01S 3/005 . { Optical devices external to the laser cavity, specially adapted for lasers, e.g. for homogenisation of the beam or for manipulating laser pulses, e.g. pulse shaping ( shaping laser beam for working metal or other materials [B23K 26/06](#) ; optical elements, systems or apparatus in general [G02B](#) ) }
- H01S 3/0057 . . { Temporal shaping, e.g. pulse compression, frequency chirping ( soliton generation and propagation [G02F 1/3513](#) , [H01S 3/063](#) and [H01S 3/108](#) ) }
- H01S 3/0064 . . { Anti-reflection devices, e.g. optical isolators ( absorbing layers for marking or protecting purposes in laser working [B23K 26/0054](#) ; magneto-optical non-reciprocal devices [G02F 1/093](#) , [G02F 1/0955](#) ) }
- H01S 3/0071 . . { Beam steering, e.g. whereby a mirror outside the cavity is present to change the beam direction }
- H01S 3/0078 . . { Frequency filtering }
- H01S 3/0085 . . { Modulating the output, i.e. the laser beam is modulated outside the laser cavity }
- H01S 3/0092 . . { Nonlinear frequency conversion, e.g. second harmonic generation [SHG ] or sum- or difference-frequency generation outside the laser cavity ( nonlinear frequency conversion per se [G02F 1/35](#) ) }
  
- H01S 3/02 . Constructional details {( housings or packages of fibre lasers [H01S 3/06704](#) ) }
- H01S 3/022 . . { of liquid lasers }
- H01S 3/025 . . { of solid state lasers, e.g. housings or mountings }
- H01S 3/027 . . . { comprising a special atmosphere inside the housing }
- H01S 3/03 . . of gas laser discharge tubes {( gas discharge tubes in general [H01J 17/00](#) , [H01J 61/00](#) ) }
- H01S 3/0305 . . . { Selection of materials for the tube or the coatings thereon }
- H01S 3/031 . . . { Metal vapour lasers, e.g. metal vapour generation }
- H01S 3/0315 . . . { Waveguide lasers }
- H01S 3/032 . . . for confinement of the discharge, e.g. by special features of the discharge constricting tube
- H01S 3/0323 . . . . { by special features of the discharge constricting tube, e.g. capillary }
- H01S 3/0326 . . . . { by an electromagnetic field }
- H01S 3/034 . . . Optical devices within, or forming part of, the tube, e.g. windows, mirrors ( reflectors having variable properties or position for initial adjustment of the resonator [H01S 3/086](#) )
- H01S 3/0343 . . . . { Aerodynamic windows }
- H01S 3/0346 . . . . { Protection of windows or mirrors against deleterious effects ( cooling arrangements [H01S 3/0401](#) ) }
- 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; cooling arrangements for gas lasers [H01S 3/041](#) ; gas dynamic lasers [H01S 3/0979](#) ; in general [H01J 17/22](#) , [H01J 61/24](#) ) }
- H01S 3/038 . . . Electrodes, e.g. special shape, configuration or composition
- H01S 3/0381 . . . . { Anodes or particular adaptations thereof }
- H01S 3/0382 . . . . { Cathodes or particular adaptations thereof }
- H01S 3/0384 . . . . { Auxiliary electrodes, e.g. for pre-ionisation or triggering, or particular adaptations therefor }
- H01S 3/0385 . . . . { Shape }
- H01S 3/0387 . . . . . { Helical shape }

H01S 3/0388	....	{ Compositions, materials or coatings }
H01S 3/04	..	Cooling arrangements
H01S 3/0401	...	{ of optical elements being part of laser resonator, e.g. windows, mirrors, lenses }
H01S 3/0402	...	{ for liquid lasers }
H01S 3/0404	...	{ Air- or gas cooling, e.g. by dry nitrogen }
H01S 3/0405	...	{ Conductive cooling, e.g. by heat sinks or thermo-electric elements }
H01S 3/0407	...	{ Liquid cooling, e.g. by water }
H01S 3/0408	...	{ Radiative cooling, e.g. by anti-Stokes scattering in the active medium }
H01S 3/041	...	for gas lasers {( <a href="#">H01S 3/0401</a> takes precedence )}
H01S 3/042	...	for solid state lasers {( <a href="#">H01S 3/0401</a> takes precedence )}
H01S 3/05	.	Construction or shape of optical resonators; Accomodation of active medium therein; Shape of active medium
H01S 3/06	..	Construction or shape of active medium
H01S 3/0602	...	{ Crystal lasers or glass lasers ( <a href="#">H01S 3/063</a> takes precedence )}
H01S 3/0604	....	{ in the form of a plate or disc }
H01S 3/0606	....	{ with polygonal cross-section, e.g. slab, prism ( <a href="#">H01S 3/0604</a> takes precedence )}
H01S 3/0608	....	{ Laser crystal with a hole, e.g. a hole or bore for housing a flashlamp or a mirror }
H01S 3/061	....	{ with elliptical or circular cross-section and elongated shape, e.g. rod }
H01S 3/0612	....	{ Non-homogeneous structure ( <a href="#">H01S 3/07</a> takes precedence )}
H01S 3/0615	....	{ Shape of end-face }
H01S 3/0617	....	{ having a varying composition or cross-section in a specific direction }
H01S 3/0619	...	{ Coatings, e.g. AR, HR, passivation layer }
H01S 3/0621	....	{ Coatings on the end-faces, e.g. input/output surfaces of the laser light }
H01S 3/0623	.....	{ Antireflective (AR) }
H01S 3/0625	....	{ Coatings on surfaces other than the end-faces }
H01S 3/0627	...	{ the resonator being monolithic, e.g. microlaser }
H01S 3/063	...	Waveguide lasers, { i.e. whereby the dimensions of the waveguide are of the order of the light wavelength ( <a href="#">waveguide gas lasers H01S 3/0315</a> )}
H01S 3/0632	....	{ Thin film lasers in which light propagates in the plane of the thin film }
H01S 3/0635	.....	{ provided with a periodic structure, e.g. using distributed feed-back, grating couplers ( <a href="#">controlling, e.g. modulating distributed feed-back lasers H01S 3/102</a> )}
H01S 3/0637	.....	{ Integrated lateral waveguide, e.g. the active waveguide is integrated on a substrate made by Si on insulator technology (Si/SiO <sub>2</sub> ) }
H01S 3/067	....	Fibre lasers {( <a href="#">optical pumping thereof H01S 3/094003</a> ; <a href="#">controlling the output parameters H01S 3/10</a> ; <a href="#">stabilisation of the output parameters H01S 3/13</a> ; characterised by scattering effects, i.e. stimulated Brillouin or Raman effects, <a href="#">H01S 3/302</a> )}
H01S 3/06704	.....	{ Housings; Packages }
H01S 3/06708	.....	{ Constructional details of the fibre, e.g. compositions, cross-section, shape or tapering ( <a href="#">optical fibres as passive waveguides G02B 6/02</a> )}
H01S 3/06712	.....	{ Polarising fibre; Polariser }

H01S 3/06716	.....	{ Fibre compositions ( per se <a href="#">C03C 13/04</a> ) or doping with active elements ( <a href="#">lasing materials in general H01S 3/14</a> ) }
H01S 3/0672	.....	{ Non-uniform radial doping }
H01S 3/06725	.....	{ Fibre characterized by a specific dispersion, e.g. for pulse shaping in soliton lasers or for dispersion compensating [DCF] }
H01S 3/06729	.....	{ Peculiar transverse fibre profile }
H01S 3/06733	.....	{ Fibre having more than one cladding }
H01S 3/06737	.....	{ Fibre having multiple non-coaxial cores, e.g. multiple active cores or separate cores for pump and gain }
H01S 3/06741	.....	{ Photonic crystal fibre, i.e. the fibre having a photonic bandgap }
H01S 3/06745	.....	{ Tapering of the fibre, core or active region }
H01S 3/0675	.....	{ Resonators including a grating structure, e.g. distributed Bragg reflectors (DBR) or distributed feedback (DFB) fibre lasers }
H01S 3/06754	.....	{ Fibre amplifiers ( <a href="#">H01S 3/06708</a> takes precedence ) }
H01S 3/06758	.....	{ Tandem amplifiers }
H01S 3/06762	.....	{ having a specific amplification band }
H01S 3/06766	.....	{ C-band amplifiers, i.e. amplification in the range of about 1530 nm to 1560 nm }
H01S 3/0677	.....	{ L-band amplifiers, i.e. amplification in the range of about 1560 nm to 1610 nm }
H01S 3/06775	.....	{ S-band amplifiers, i.e. amplification in the range of about 1450 nm to 1530 nm }
H01S 3/06779	.....	{ with optical power limiting }
H01S 3/06783	.....	{ Amplifying coupler }
H01S 3/06787	.....	{ Bidirectional amplifier }
H01S 3/06791	.....	{ Fibre ring lasers ( <a href="#">fibre laser gyrometers G01C 19/72</a> ) }
H01S 3/06795	.....	{ with superfluorescent emission, e.g. amplified spontaneous emission sources for fibre laser gyrometers ( <a href="#">fibre laser gyrometers per se G01C 19/72</a> ) }
H01S 3/07	...	consisting of a plurality of parts, e.g. segments ( <a href="#">H01S 3/067</a> takes precedence )
H01S 3/073	....	{ Gas lasers comprising separate discharge sections in one cavity, e.g. hybrid lasers ( <a href="#">tandem arrangements of separate gas lasers H01S 3/2366</a> ) }
H01S 3/076	.....	{ Folded-path lasers }
H01S 3/08	..	Construction or shape of optical resonators or components thereof {( <a href="#">waveguide lasers H01S 3/063</a> ; controlling the laser output <a href="#">H01S 3/10</a> ; stabilising <a href="#">H01S 3/13</a> ) }
H01S 3/08004	...	{ incorporating a dispersive element, e.g. a prism for wavelength selection ( <a href="#">H01S 3/0811</a> , <a href="#">H01S 3/08022</a> take precedence ) }
H01S 3/08009	....	{ using a diffraction grating }
H01S 3/08013	...	{ Resonator comprising a fibre, e.g. for modifying dispersion or repetition rate } ( <a href="#">the active medium being a fibre H01S 3/067</a> )
H01S 3/08018	...	{ Mode suppression }
H01S 3/08022	....	{ Longitudinal mode control, e.g. specifically multimode }
H01S 3/08027	.....	{ by a filter, e.g. a Fabry-Perot filter is used for wavelength setting }
H01S 3/08031	.....	{ Single-mode emission }

H01S 3/08036	.....	{ by a dispersive, polarising or birefringent element placed in the cavity, e.g. a Fabry-Perot etalon, tilted plate }
H01S 3/0804	....	{ Transverse or lateral mode control, e.g. specifically multimode }
H01S 3/08045	.....	{ Single-mode emission }
H01S 3/0805	.....	{ by apertures, e.g. pinholes, knife-edges, apodizers }
H01S 3/08054	...	{ Passive cavity elements acting on the polarization, e.g. a polarizer for branching or walk-off compensation ( <a href="#">quarter-wave plates in a Q-switch laser H01S 3/1124</a> , <a href="#">H01S 3/115</a> ) }
H01S 3/08059	...	{ Constructional details of the reflector, e.g. shape ( <a href="#">mirrors in general G02B 5/08</a> ; mountings for mirrors <a href="#">G02B 7/18</a> ) }
H01S 3/08063	....	{ Graded reflectivity, e.g. variable reflectivity mirror }
H01S 3/08068	....	{ Holes; Stepped surface; Special cross-section }
H01S 3/08072	...	{ Thermal lensing or thermally induced birefringence; Compensation thereof }
H01S 3/08077	....	{ Pump induced waveguiding, i.e. the pump induces refractive index change in the laser medium to guide the amplified light, e.g. gain- or loss- guiding or thermally induced refractive index change }
H01S 3/08081	...	{ Unstable resonators }
H01S 3/08086	...	{ Multiple-wavelength emission }
H01S 3/0809	....	{ Two-wavelength emission }
H01S 3/08095	...	{ Zig-zag travelling beam through the active medium }
H01S 3/081	...	comprising more than two reflectors ( <a href="#">folded-path gas lasers H01S 3/076</a> ) }
H01S 3/0811	....	{ incorporating a dispersive element, e.g. a prism for wavelength selection }
H01S 3/0812	.....	{ using a diffraction grating }
H01S 3/0813	....	{ Configuration of resonator }
H01S 3/0815	.....	{ having 3 reflectors, i.e. V-shaped resonators }
H01S 3/0816	.....	{ having 4 reflectors, i.e. Z-shaped resonators }
H01S 3/0817	.....	{ having 5 reflectors, i.e. W-shaped resonators }
H01S 3/0818	....	{ Unstable resonators }
H01S 3/082	....	defining a plurality of resonators, e.g. for mode selection ( <a href="#">single longitudinal mode control H01S 3/08022</a> ) }
H01S 3/0823	.....	{ incorporating a dispersive element, e.g. a prism for wavelength selection }
H01S 3/0826	.....	{ using a diffraction grating }
H01S 3/083	....	Ring lasers ( <a href="#">ring laser gyrometers G01C 19/66</a> ; { <a href="#">fibre ring lasers H01S 3/06791</a> } )
H01S 3/0835	.....	{ Gas ring lasers }
H01S 3/086	...	One or more reflectors having variable properties or positions for initial adjustment of the resonator ( <a href="#">varying a parameter of the laser output during operation H01S 3/10</a> ; <a href="#">stabilisation of the laser output H01S 3/13</a> )
H01S 3/09	.	Processes or apparatus for excitation, e.g. pumping
H01S 3/0903	..	{ Free-electron laser }
H01S 3/0906	..	{ Electrical, electrochemical, or electron-beam pumping of a dye laser }
H01S 3/091	..	using optical pumping
H01S 3/0912	...	{ Electronics or drivers for the pump source, i.e. details of drivers or circuitry specific for laser pumping ( <a href="#">laser diode drivers H01S 5/042</a> ) }

H01S 3/0915	...	by incoherent light
H01S 3/09155	....	{ by cathodo-luminescence }
H01S 3/092	....	of flash lamp ( <a href="#">H01S 3/0937</a> takes precedence; {( flash lamps per se <a href="#">H01J 61/80</a> ; circuit arrangements for operating flash lamps in general <a href="#">H05B 41/30</a> )})
H01S 3/093	.....	focusing or directing the excitation energy into the active medium
H01S 3/0931	.....	{ Imaging pump cavity, e.g. elliptical }
H01S 3/0933	....	of a semiconductor, e.g. light emitting diode
H01S 3/0937	....	produced by exploding or combustible material
H01S 3/094	...	by coherent light

**NOTE**

Groups [H01S 3/094003](#) to [H01S 3/094088](#) take precedence over groups [H01S 3/0941](#) to [H01S 3/0947](#)

H01S 3/094003	....	{ the pumped medium being a fibre }
H01S 3/094007	.....	{ Cladding pumping, i.e. pump light propagating in a clad surrounding the active core }
H01S 3/094011	.....	{ with bidirectional pumping, i.e. with injection of the pump light from both two ends of the fibre }
H01S 3/094015	.....	{ with pump light recycling, i.e. with reinjection of the unused pump light back into the fiber, e.g. by reflectors or circulators }
H01S 3/094019	.....	{ Side pumped fibre, whereby pump light is coupled laterally into the fibre via an optical component like a prism, or a grating , or via V-groove coupling }
H01S 3/094023	.....	{ with ASE light recycling, with reinjection of the ASE light back into the fiber, e.g. by reflectors or circulators }
H01S 3/094026	....	{ for synchronously pumping, e.g. for mode-locking }
H01S 3/09403	....	{ Cross-pumping, e.g. Förster process involving intermediate medium for excitation transfer }
H01S 3/094034	....	{ the pumped medium being a dye }
H01S 3/094038	....	{ End pumping }
H01S 3/094042	....	{ of a fibre laser }
H01S 3/094046	.....	{ of a Raman fibre laser }
H01S 3/094049	....	{ Guiding of the pump light }
H01S 3/094053	.....	{ Fibre coupled pump, e.g. delivering pump light using a fibre or a fibre bundle }
H01S 3/094057	.....	{ by tapered duct or homogenized light pipe, e.g. for concentrating pump light }
H01S 3/094061	....	{ Shared pump, i.e. pump light of a single pump source is used to pump plural gain media in parallel }
H01S 3/094065	....	{ Single-mode pumping }
H01S 3/094069	....	{ Multi-mode pumping }
H01S 3/094073	....	{ Non-polarized pump, e.g. depolarizing the pump light for Raman lasers }
H01S 3/094076	....	{ Pulsed or modulated pumping ( <a href="#">H01S 3/1024</a> takes precedence ) }
H01S 3/09408	....	{ Pump redundancy }



- H01S 3/094084 . . . . { with pump light recycling, i.e. with reinjection of the unused pump light, e.g. by reflectors or circulators }
- H01S 3/094088 . . . . { with ASE light recycling, i.e. with reinjection of the ASE light, e.g. by reflectors or circulators }
- H01S 3/094092 . . . . { Upconversion pumping }
- H01S 3/094096 . . . . { Multi-wavelength pumping }
- H01S 3/0941 . . . . of a laser diode
- H01S 3/09415 . . . . { the pumping beam being parallel to the lasing mode of the pumped medium, e.g. end-pumping }
- H01S 3/0943 . . . . of a gas laser
- H01S 3/0947 . . . . of an organic dye laser
- H01S 3/095 . . using chemical or thermal pumping ({ [generating plasma, e.g. by combustion H02K 44/00](#) , [H05H 1/24](#) })
- H01S 3/09505 . . . { involving photochemical reactions, e.g. photodissociation ( [Iodine lasers H01S 3/2215](#) ) }
- H01S 3/0951 . . . by increasing the pressure in the laser gas medium
- H01S 3/0953 . . . . Gas dynamic laser, i.e. with expansion of the laser gas medium to supersonic flow speeds
- H01S 3/0955 . . using pumping by high energy particles ({ [H01S 3/0903](#) , [H01S 3/0906](#) , [H01S 3/09707](#) take precedence })
- H01S 3/0957 . . . by high energy nuclear particles
- H01S 3/0959 . . . by an electron beam
- H01S 3/097 . . by gas discharge of a gas laser
- H01S 3/09702 . . . { Details of the driver electronics and electric discharge circuits }
- H01S 3/09705 . . . { with particular means for stabilising the discharge }
- H01S 3/09707 . . . { using an electron or ion beam ( [free-electron laser H01S 3/0903](#) ) }
- H01S 3/0971 . . . transversely excited ( [H01S 3/0975](#) takes precedence )
- H01S 3/09713 . . . . { with auxiliary ionisation, e.g. double discharge excitation }
- H01S 3/09716 . . . . { by ionising radiation }
- H01S 3/0973 . . . . having a travelling wave passing through the active medium
- H01S 3/0975 . . . using inductive or capacitive excitation
- H01S 3/0977 . . . having auxiliary ionisation means ({ [H01S 3/09713](#) takes precedence })
- H01S 3/09775 . . . . { by ionising radiation }
- H01S 3/0979 . . . Gas dynamic lasers, i.e. with expansion of the laser gas medium to supersonic flow speeds
  
- H01S 3/10 . . Controlling the intensity, frequency, phase, polarisation or direction of the emitted radiation, e.g. switching, gating, modulating or demodulating ( [mode locking H01S 3/1106](#) ); controlling of light beams, frequency-changing, non-linear optics, optical logic elements, in general [G02F](#) )

**NOTE**

Group [H01S 3/10007](#) takes precedence over groups [H01S 3/102](#) to [H01S 3/104](#)

- H01S 3/10007 . . { in optical amplifiers }
- H01S 3/10015 . . . { by monitoring or controlling, e.g. attenuating, the input signal }

H01S 3/10023	...	{ by functional association of additional optical elements, e.g. filters, gratings, reflectors }
H01S 3/1003	....	{ turnable optical elements, e.g. acousto-optic filters, tunable gratings }
H01S 3/10038	..	{ Amplitude control }
H01S 3/10046	...	{ Pulse repetition rate control ( <a href="#">H01S 3/11</a> takes precedence ) }
H01S 3/10053	..	{ Phase control }
H01S 3/10061	..	{ Polarization control }
H01S 3/10069	..	{ Memorized or pre-programmed characteristics, e.g. look-up table [LUT] }
H01S 3/10076	..	{ using optical phase conjugation, e.g. phase conjugate reflection }
H01S 3/10084	..	{ Frequency control by seeding }
H01S 3/10092	...	{ Coherent seed, e.g. injection locking }
H01S 3/101	..	Lasers provided with means to change the location from which, or the direction in which, laser radiation is emitted ( <a href="#">optical-mechanical scanning systems in general G02B 26/10</a> ; <a href="#">electro-, magneto- or acousto-optical deflection G02F 1/29</a> ; { control of position or direction of light beam generating device in general <a href="#">G05D 3/00</a> } )
H01S 3/102	..	by controlling the active medium, e.g. by controlling the processes or apparatus for excitation ( <a href="#">H01S 3/13</a> takes precedence )
H01S 3/1022	...	{ by controlling the optical pumping }
H01S 3/1024	....	{ for pulse generation }
H01S 3/1026	...	{ Controlling the active medium by translation or rotation, e.g. to remove heat from that part of the active medium that is situated on the resonator axis }
H01S 3/1028	...	{ by controlling the temperature }
H01S 3/104	...	in gas lasers
H01S 3/105	..	by controlling the mutual position or the reflecting properties of the reflectors of the cavity { e.g. by controlling the cavity length } ( { <a href="#">H01S 3/10076</a> }, <a href="#">H01S 3/13</a> take precedence )
H01S 3/1051	...	{ one of the reflectors being of the type using frustrated reflection }
H01S 3/1053	...	{ Control by pressure or deformation }
H01S 3/1055	...	one of the reflectors being constituted by a diffraction grating
H01S 3/106	..	by controlling a device placed within the cavity ( { <a href="#">H01S 3/10076</a> }, <a href="#">H01S 3/13</a> take precedence )
H01S 3/1061	...	{ using a variable absorption device }
H01S 3/1062	...	{ using a controlled passive interferometer, e.g. a Fabry-Perot etalon }
H01S 3/1063	...	{ using a solid state device provided with at least one potential jump barrier }
H01S 3/1065	...	{ using liquid crystals }
H01S 3/1066	...	{ using a magneto-optical device }
H01S 3/1067	...	{ using pressure or deformation }
H01S 3/1068	...	{ using an acousto-optical device }
H01S 3/107	...	using an electro-optical device, e.g. exhibiting Pockels- or Kerr-effect ( { <a href="#">H01S 3/1061</a> , <a href="#">H01S 3/1063</a> , <a href="#">H01S 3/1065</a> take precedence } )
H01S 3/1075	....	{ for optical deflection }
H01S 3/108	...	using a non-linear optical device, e.g. exhibiting Brillouin- or Raman-scattering ( { <a href="#">mode locking using a non-linear element H01S 3/1112</a> } )
H01S 3/1083	....	{ using parametric generation }
H01S 3/1086	....	{ using scattering effects, e.g. Raman or Brillouin effect }



H01S 3/109	....	Frequency multiplying, e.g. harmonic generation
H01S 3/1095	.....	{ self doubling, e.g. lasing and frequency doubling by the same active medium }
H01S 3/11	..	{ Pulse generation, e.g. Q-switching, mode locking }
H01S 3/1103	...	{ Cavity dumping }
H01S 3/1106	...	{ Mode locking }
H01S 3/1109	....	{ Active mode locking }
H01S 3/1112	....	{ Passive mode locking }
H01S 3/1115	.....	{ using a saturable absorber ( Q-switching by saturable absorbers <a href="#">H01S 3/113</a> ) }
H01S 3/1118	.....	{ Solid state absorber, e.g. SESAM }
H01S 3/1121	....	{ Harmonically mode-locked lasers, e.g. modulation frequency equals multiple integers or a fraction of the resonator roundtrip time }
H01S 3/1124	...	{ Q-switching using magneto-optical devices }
H01S 3/1127	...	{ Q-switching using pulse transmission mode (PTM) }
H01S 3/113	...	{ Q-switching }using bleachable or solarising media
H01S 3/115	...	{ Q-switching }using electro-optical devices
H01S 3/117	...	{ Q-switching }using acousto-optical devices
H01S 3/121	...	{ Q-switching }using mechanical devices
H01S 3/123	....	Rotating mirror
H01S 3/125	....	Rotating prism
H01S 3/127	...	Plural Q-switches
H01S 3/13	..	Stabilisation of laser output parameters, e.g. frequency, amplitude

**NOTE**

Group [H01S 3/1301](#) takes precedence over groups [H01S 3/131](#) to [H01S 3/134](#)

H01S 3/1301	...	{ in optical amplifiers }
H01S 3/1302	....	{ by all-optical means, e.g. gain-clamping }
H01S 3/1303	...	{ by using a passive reference, e.g. absorption cell ( <a href="#">H01S 3/139</a> takes precedence ) }
H01S 3/1304	...	{ by using an active reference, e.g. second laser, klystron or other standard frequency source ( <a href="#">H01S 3/139</a> takes precedence; automatic control of electronic generators <a href="#">H03L 7/00</a> ) }
H01S 3/1305	...	{ Feedback control systems }
H01S 3/1306	...	{ Stabilisation of the amplitude }
H01S 3/1307	...	{ Stabilisation of the phase }
H01S 3/1308	...	{ Stabilisation of the polarisation }
H01S 3/131	...	by controlling the active medium, e.g. by controlling the processes or apparatus for excitation
H01S 3/1312	....	{ by controlling the optical pumping }
H01S 3/1315	....	{ by gain saturation }
H01S 3/1317	....	{ by controlling the temperature }
H01S 3/134	....	in gas lasers

H01S 3/136	...	by controlling a device placed within the cavity
H01S 3/137	....	for stabilising of frequency
H01S 3/139	...	by controlling the mutual position or the reflecting properties of the reflectors of the cavity { e.g. by controlling the cavity length }
H01S 3/1392	....	{ by using a passive reference, e.g. absorption cell ( <a href="#">H01S 3/1396</a> , <a href="#">H01S 3/1398</a> take precedence ) }
H01S 3/1394	....	{ by using an active reference, e.g. second laser, klystron or other standard frequency source }
H01S 3/1396	....	{ by using two modes present, e.g. Zeeman splitting ( <a href="#">H01S 3/1398</a> takes precedence ) }
H01S 3/1398	....	{ by using a supplementary modulation of the output }
H01S 3/14	.	characterised by the material used as the active medium
H01S 3/16	..	Solid materials
H01S 3/1601	...	{ characterised by an active (lasing) ion }
H01S 3/1603	....	{ rare earth }
H01S 3/1605	.....	{ terbium }
H01S 3/1606	.....	{ dysprosium }
H01S 3/1608	.....	{ erbium }
H01S 3/161	.....	{ holmium }
H01S 3/1611	.....	{ neodymium }
H01S 3/1613	.....	{ praseodymium }
H01S 3/1615	.....	{ samarium }
H01S 3/1616	.....	{ thulium }
H01S 3/1618	.....	{ ytterbium }
H01S 3/162	....	{ transition metal }
H01S 3/1621	.....	{ cobalt }
H01S 3/1623	.....	{ chromium, e.g. Alexandrite }
H01S 3/1625	.....	{ titanium }
H01S 3/1626	....	{ uranium }
H01S 3/1628	...	{ characterised by a semiconducting matrix }
H01S 3/163	...	{ characterised by a crystal matrix }
H01S 3/1631	....	{ aluminate }
H01S 3/1633	.....	{ $\text{BeAl}_2\text{O}_4$ i.e. Chrysoberyl }
H01S 3/1635	.....	{ $\text{LaMgAl}_{11}\text{O}_{19}$ ( LNA, Lanthanum Magnesium Hexaluminate ) }
H01S 3/1636	.....	{ $\text{Al}_2\text{O}_3$ (Sapphire) }
H01S 3/1638	.....	{ $\text{YAlO}_3$ ( YALO or YAP, Yttrium Aluminium Perovskite ) }
H01S 3/164	....	{ garnet }
H01S 3/1641	.....	{ GGG }
H01S 3/1643	.....	{ YAG }
H01S 3/1645	....	{ halide }
H01S 3/1646	.....	{ $\text{BaY}_2\text{F}_8$ }
H01S 3/1648	.....	{ with the formula $\text{XYZF}_6$ ( Colquiriite structure ), wherein X is Li, Na, K or Rb, Y is Mg, Ca, Sr, Cd or Ba and Z is Al, Sc or Ga }

H01S 3/165	.....	{ with the formula MF <sub>2</sub> , wherein M is Ca, Sr or Ba }
H01S 3/1651	.....	{ SrAlF <sub>5</sub> }
H01S 3/1653	.....	{ YLiF <sub>4</sub> ( YLF, LYF ) }
H01S 3/1655	.....	{ silicate }
H01S 3/1656	.....	{ BeAl <sub>2</sub> (SiO <sub>3</sub> ) <sub>6</sub> }
H01S 3/1658	.....	{ Mg <sub>2</sub> SiO <sub>4</sub> (Forsterite) }
H01S 3/166	.....	{ La <sub>3</sub> Ga <sub>5</sub> SiO <sub>14</sub> (LGS) }
H01S 3/1661	.....	{ Y <sub>2</sub> SiO <sub>5</sub> (YSO) }
H01S 3/1663	.....	{ beryllate }
H01S 3/1665	.....	{ La <sub>2</sub> Be <sub>2</sub> O <sub>5</sub> (BEL) }
H01S 3/1666	.....	{ borate, carbonate, arsenide }
H01S 3/1668	.....	{ scandate }
H01S 3/167	.....	{ Sc <sub>2</sub> O <sub>3</sub> }
H01S 3/1671	.....	{ vanadate, niobate, tantalate }
H01S 3/1673	.....	{ YVO <sub>4</sub> (YVO) }
H01S 3/1675	.....	{ titanate, germanate, molybdate, tungstate }
H01S 3/1676	.....	{ Li <sub>4</sub> Ge <sub>5</sub> O <sub>12</sub> }
H01S 3/1678	.....	{ LaBGeO <sub>5</sub> }
H01S 3/168	...	{ using an organic dye dispersed in a solid matrix }
H01S 3/1681	...	{ using colour centres }
H01S 3/1683	...	{ using superconductivity e.g. provided with Josephson junctions }
H01S 3/1685	...	{ Ceramics }
H01S 3/1686	...	{ Liquid crystal active layer }
H01S 3/1688	...	{ Stoichiometric laser compounds, i.e. in which the active element forms one component of a stoichiometric formula rather than being merely a dopant }
H01S 3/169	...	{ Nanoparticles, e.g. doped nanoparticles acting as a gain material }
H01S 3/1691	...	{ characterised by additives / sensitisers / promoters as further dopants }
H01S 3/1693	.....	{ aluminium }
H01S 3/1695	.....	{ germanium }
H01S 3/1696	.....	{ transition metal }
H01S 3/1698	.....	{ rare earth }
H01S 3/17	...	amorphous, e.g. glass {( <a href="#">glass manufacture, shaping or supplementary processes C03B</a> ; compositions for laserable glass <a href="#">C03C 4/0071</a> )}
H01S 3/171	.....	{ chalcogenide glass }
H01S 3/172	.....	{ selenide glass }
H01S 3/173	.....	{ fluoride glass, e.g. fluorozirconate or ZBLAN [ ZrF <sub>4</sub> -BaF <sub>2</sub> -LaF <sub>3</sub> -AlF <sub>3</sub> -NaF ] }
H01S 3/175	.....	{ phosphate glass }
H01S 3/176	.....	{ silica or silicate glass }
H01S 3/177	.....	{ telluride glass }
H01S 3/178	.....	{ plastic }
H01S 3/20	..	Liquids
H01S 3/207	...	including a chelate { e.g. including atoms or ions, e.g. Nd }
H01S 3/213	...	including an organic dye

- H01S 3/22 .. Gases
- H01S 3/2207 ... { Noble gas ions, e.g. Ar+>, Kr+> }
- H01S 3/2215 ... { Iodine compounds or atomic iodine }
- H01S 3/2222 ... { Neon, e.g. in helium-neon (He-Ne) systems }
- H01S 3/223 ... the active gas being polyatomic, i.e. containing more than one atom ( [H01S 3/227](#) takes precedence )
- H01S 3/2232 .... { Carbon dioxide (CO<sub>2</sub>) or monoxide (CO) }
- H01S 3/2235 .... { Dye vapour }
- H01S 3/2237 .... { Molecular nitrogen (N<sub>2</sub>), e.g. in noble gas-N<sub>2</sub> systems }
- H01S 3/225 .... comprising an excimer or exciplex
- H01S 3/2251 ..... { ArF, i.e. argon fluoride is comprised for lasing around 193 nm }
- H01S 3/2253 ..... { XeCl, i.e. xenon chloride is comprised for lasing around 308 nm }
- H01S 3/2255 ..... { XeF, i.e. xenon fluoride is comprised for lasing around 351 nm }
- H01S 3/2256 ..... { KrF, i.e. krypton fluoride is comprised for lasing around 248 nm }
- H01S 3/2258 ..... { F<sub>2</sub>, i.e. molecular fluoride is comprised for lasing around 157 nm }
- H01S 3/227 ... Metal vapour
- H01S 3/23 . Arrangements of two or more lasers not provided for in groups [H01S 3/02](#) to [H01S 3/22](#) , e.g. tandem arrangements of separate active media
- H01S 3/2308 .. { Amplifier arrangements, e.g. MOPA }
- H01S 3/2316 ... { Cascaded amplifiers }
- H01S 3/2325 ... { Multi-pass amplifiers, e.g. regenerative amplifiers }
- H01S 3/2333 .... { Double-pass amplifiers }
- H01S 3/2341 .... { Four pass amplifiers }
- H01S 3/235 .... { Regenerative amplifiers }
- H01S 3/2358 .. { comprising dyes as the active medium }
- H01S 3/2366 .. { comprising a gas as the active medium ( [H01S 3/10092](#) , [H01S 3/2383](#) take precedence )}
- H01S 3/2375 .. { Hybrid lasers ( [H01S 3/07](#) takes precedence ) }
- H01S 3/2383 .. { Parallel arrangements }
- H01S 3/2391 ... { emitting at different wavelengths }
- H01S 3/30 . using scattering effects, e.g. stimulated Brillouin or Raman effects
- H01S 3/302 .. { in an optical fibre }
- H01S 3/305 .. { in a gas }
- H01S 3/307 .. { in a liquid }
- H01S 4/00** **Devices using stimulated emission or wave energy other than those covered by groups [H01S 1/00](#) or [H01S 3/00](#) , e.g. phonon maser, gamma maser**
- H01S 5/00** **Semiconductor lasers** ({ [superluminescent diodes](#) [H01L 33/0045](#) })
- H01S 5/0014 . { Measuring characteristics or properties thereof ( measuring techniques per se [G01J](#), [G01K](#), [G01N](#), [G01R](#) ) }

- H01S 5/0021 .. { Degradation or life time measurements }
- H01S 5/0028 .. { Laser diodes used as detectors }
- H01S 5/0035 .. { Simulations of laser characteristics }
- H01S 5/0042 .. { On wafer testing, e.g. lasers are tested before separating wafer into chips }
  
- H01S 5/005 . { Optical devices 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 5/026](#) , [H01S 5/18388](#) take precedence ) }
- H01S 5/0057 .. { Temporal shaping, e.g. pulse compression, frequency chirping }
- H01S 5/0064 .. { Anti-reflection devices, e.g. optical isolators }
- H01S 5/0071 .. { Beam steering, e.g. whereby a mirror outside the cavity is present to change the beam direction }
- H01S 5/0078 .. { Frequency filtering }
- H01S 5/0085 .. { Modulating the output, i.e. the laser beam is modulated outside the laser cavity }
- H01S 5/0092 .. { Nonlinear frequency conversion, e.g. second harmonic generation [SHG ] or sum- or difference-frequency generation outside the laser cavity ( [nonlinear frequency conversion per se G02F 1/35](#) ) }
  
- H01S 5/02 . Structural details or components not essential to laser action
- H01S 5/0201 .. { Separation of the wafer into individual elements, e.g. by dicing, cleaving, etching or directly during growth }
- H01S 5/0202 ... { Cleaving }
- H01S 5/0203 ... { Etching }
- H01S 5/0205 ... { during growth of the semiconductor body }
- H01S 5/0206 .. { Substrates, e.g. growth, shape, material, removal or bonding; ( [specific crystal orientation H01S 5/3202](#) ) }
- H01S 5/0207 ... { Substrates having a special shape }
- H01S 5/0208 ... { Semi-insulating substrates }
- H01S 5/021 ... { Silicon based substrates }
- H01S 5/0211 ... { Substrates made of ternary or quaternary compounds }
- H01S 5/0212 .... { with a graded composition }
- H01S 5/0213 ... { Sapphire, quartz or diamond based substrates }
- H01S 5/0215 ... { Bonding to the substrate }
- H01S 5/0216 .... { using an intermediate compound, e.g. a glue or solder }
- H01S 5/0217 ... { Removal of the substrate }
- H01S 5/0218 ... { Substrates comprising semiconducting materials from different groups of the periodic system than the active layer }
- H01S 5/022 .. { Mountings; Housings ( [packaging and electrical lead-through per se H01L 23/00](#) ) }
- H01S 5/02204 ... { including a getter material to absorb contaminations }
- H01S 5/02208 ... { Shape of the housing }
- H01S 5/02212 .... { Can-type, e.g. TO-9 housing with emission along or parallel to symmetry axis }
- H01S 5/02216 .... { Butterfly-type, i.e. the housing is generally flat }
- H01S 5/0222 ... { filled with special gases }
- H01S 5/02224 .... { Oxygen is contained in the housing, e.g. to avoid contamination of the light }

		emitting facet }
H01S 5/02228	...	{ filled with a resin, or the complete housing being made of resin }
H01S 5/02232	...	{ filled with a liquid ( <a href="#">H01S 5/0243</a> takes precedence ) }
H01S 5/02236	...	{ Mounts or sub-mounts ( <a href="#">H01S 5/02476</a> takes precedence ) }
H01S 5/0224	....	{ Up-side down mounting, e.g. flip-chip or epi-side down mounted laser }
H01S 5/02244	....	{ Lead-frames, e.g. the laser is mounted on a lead frame or on a stem }
H01S 5/02248	....	{ Mechanically integrated components on a mount or an optical micro-bench, e.g. optical components, detectors, etc. }
H01S 5/02252	.....	{ Relative positioning of laser diode and optical components, e.g. grooves in the mount to fix an optical fibre or a lens }
H01S 5/02256	....	{ Details of fixing the laser diode on the mount }
H01S 5/0226	.....	{ using an adhesive }
H01S 5/02264	.....	{ by clamping }
H01S 5/02268	.....	{ Positioning, e.g. using marks for positioning of the laser diode }
H01S 5/02272	.....	{ using soldering }
H01S 5/02276	....	{ Wire-bonding details }
H01S 5/0228	...	{ Out-coupling light }
H01S 5/02284	....	{ with an optical fibre }
H01S 5/02288	....	{ with a lens }
H01S 5/02292	....	{ with a beam deflecting element }
H01S 5/02296	....	{ Details of a window, e.g. special materials or special orientation for back-reflecting light to a detector inside the housing }
H01S 5/024	..	Cooling arrangements ( { <a href="#">cooling solid state junction devices H01L 23/34</a> ; Heating arrangements ( <a href="#">H01S 5/0261</a> takes precedence ) } )
H01S 5/02407	...	{ Active cooling, e.g. the laser temperature is controlled by a thermo-electric cooler or water cooling }
H01S 5/02415	....	{ by using a thermo-electric cooler [TEC] , e.g. Peltier element }
H01S 5/02423	....	{ Liquid cooling, e.g. a liquid cools a mount of the laser }
H01S 5/0243	.....	{ Laser is immersed in the coolant, i.e. the whole laser chip is immersed in the liquid for cooling }
H01S 5/02438	...	{ Characterized by cooling of elements other than the laser, e.g. an optical element being part of an external cavity or a collimating lens }
H01S 5/02446	....	{ Cooling being separate from the laser cooling }
H01S 5/02453	...	{ Heating, e.g. the laser is heated for stabilisation against temperature fluctuations of the environment ( <a href="#">H01S 5/0612</a> takes precedence, for monolithically integrated heaters see also <a href="#">H01S 5/0261</a> ) }
H01S 5/02461	...	{ Structure or details of the laser chip to manipulate the heat flow, e.g. passive layers in the chip with a low heat conductivity }
H01S 5/02469	...	{ Passive cooling, e.g. where heat is removed by the housing as a whole or by a heat pipe without any active cooling element like a TEC }
H01S 5/02476	...	{ Heat spreaders, i.e. improving heat flow between laser chip and heat dissipating elements }
H01S 5/02484	....	{ Sapphire or diamond heat spreaders }
H01S 5/02492	....	{ CuW heat spreaders }
H01S 5/026	..	Monolithically integrated components, e.g. waveguides, monitoring photo-detectors, drivers ( <a href="#">stabilisation of output H01S 5/06</a> ; <a href="#">coupling light guides</a> )



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 5/0261 ... { Non-optical elements, e.g. laser driver components, heaters ( [H01S 5/0265](#) takes precedence ) }
- H01S 5/0262 ... { Photo-diodes, e.g. transceiver devices, bidirectional devices ( [H01S 5/0265](#) takes precedence ) }
- H01S 5/0264 .... { for monitoring the laser-output }
- H01S 5/0265 ... { Intensity modulators ( intracavity modulators [H01S 5/0625](#) ) }
- H01S 5/0267 ... { Integrated focusing lens ( [H01S 5/18388](#) takes precedence ) }
- H01S 5/0268 ... { Integrated waveguide grating router, e.g. emission of a multi-wavelength laser array is combined by a "dragon router" }
- H01S 5/028 .. Coatings; { Treatment of the laser facets, e.g. etching, passivation layers or reflecting layers }
- H01S 5/0281 ... { Coatings made of semiconductor materials }
- H01S 5/0282 ... { Passivation layers or treatments }
- H01S 5/0283 .... { Optically inactive coating on the facet, e.g. half-wave coating }
- H01S 5/0284 ... { Coatings with a temperature dependent reflectivity }
- H01S 5/0285 ... { Coatings with a controllable reflectivity }
- H01S 5/0286 ... { Coatings with a reflectivity that is not constant over the facets, e.g. apertures }
- H01S 5/0287 ... { Facet reflectivity }
- H01S 5/0288 .... { Detuned facet reflectivity, i.e. reflectivity peak is different from gain maximum }
  
- H01S 5/04 . Processes or apparatus for excitation, e.g. pumping, { e.g. by electron beams } ( [H01S 5/06](#) takes precedence )
- H01S 5/041 .. { Optical pumping }
- H01S 5/042 .. Electrical excitation; { Circuits therefor ( discrete or monolithically integrated laser drive components on mountings [H01S 5/0261](#) ) }
- H01S 5/0421 ... { characterised by the semiconducting contacting layers ( electrodes [H01S 5/0425](#) ) }
- H01S 5/0422 .... { with n- and p-contacts on the same side of the active layer }
- H01S 5/0424 ..... { lateral current injection }
- H01S 5/0425 ... { Electrodes, e.g. materials, shape, configuration, structure }
- H01S 5/0427 ... { for applying modulation to the laser }
- H01S 5/0428 ... { for applying pulses to the laser }
  
- H01S 5/06 . Arrangements for controlling the laser output parameters, e.g. by operating on the active medium ( transmission systems employing light [H04B 10/00](#) )
- H01S 5/0601 .. { comprising an absorbing region ( [H01S 5/0604](#) , [H01S 5/0607](#) , [H01S 5/0615](#) and [H01S 5/065](#) take precedence; bistable laser devices in general [G02F 3/026](#) ) }
- H01S 5/0602 ... { which is an unpumped part of the active layer }
- H01S 5/0604 .. { comprising a non-linear region, e.g. generating harmonics of the laser frequency }
- H01S 5/0605 ... { Self doubling, e.g. lasing and frequency doubling by the same active medium }
- H01S 5/0607 .. { by varying physical parameters other than the potential of the electrodes, e.g. by an electric or magnetic field, mechanical deformation, pressure, light, temperature }
- H01S 5/0608 ... { controlled by light, e.g. optical switch }

H01S 5/0609	....	{ acting on an absorbing region, e.g. wavelength convertors }
H01S 5/0611	.....	{ wavelength convectors }
H01S 5/0612	...	{ controlled by temperature }
H01S 5/0614	...	{ controlled by electric field, i.e. whereby an additional electric field is used to tune the bandgap, e.g. using the Stark-effect }
H01S 5/0615	..	{ Q-switching, i.e. in which the quality factor of the optical resonator is rapidly changed }
H01S 5/0617	..	{ using memorised or pre-programmed laser characteristics }
H01S 5/0618	..	{ Details on the linewidth enhancement parameter alpha }
H01S 5/062	..	by varying the potential of the electrodes ( <a href="#">H01S 5/065</a> takes precedence )
H01S 5/06203	...	{ Transistor-type lasers ( <a href="#">H01S 5/0608</a> takes precedence ) }
H01S 5/06206	....	{ Controlling the frequency of the radiation, e.g. tunable twin-guide lasers (TTG) }
H01S 5/06209	...	{ in single-section lasers ( <a href="#">H01S 5/0608</a> takes precedence ) }
H01S 5/06213	....	{ Amplitude modulation }
H01S 5/06216	....	{ Pulse modulation or generation }
H01S 5/0622	....	{ Controlling the frequency of the radiation }
H01S 5/06223	...	{ using delayed or positive feedback }
H01S 5/06226	...	{ Modulation at ultra-high frequencies }
H01S 5/0623	....	{ using the beating between two closely spaced optical frequencies, i.e. heterodyne mixing }
H01S 5/06233	...	{ Controlling other output parameters than intensity or frequency }
H01S 5/06236	....	{ controlling the polarisation, e.g. TM/TE polarisation switching }
H01S 5/0624	....	{ controlling the near- or far field }
H01S 5/06243	....	{ controlling the position or direction of the emitted beam }
H01S 5/06246	....	{ controlling the phase }
H01S 5/0625	...	in multi-section lasers
H01S 5/06251	....	{ Amplitude modulation }
H01S 5/06253	....	{ Pulse modulation }
H01S 5/06255	....	{ Controlling the frequency of the radiation }
H01S 5/06256	.....	{ with DBR-structure }
H01S 5/06258	.....	{ with DFB-structure }
H01S 5/065	..	Mode locking; Mode suppression; Mode selection; { Self pulsating }
H01S 5/0651	...	{ Mode control }
H01S 5/0652	....	{ Coherence lowering or collapse, e.g. multimode emission by additional input or modulation }
H01S 5/0653	....	{ Mode suppression, e.g. specific multimode }
H01S 5/0654	.....	{ Single longitudinal mode emission }
H01S 5/0655	.....	{ Single transverse or lateral mode emission }
H01S 5/0656	...	{ Seeding, i.e. an additional light input is provided for controlling the laser modes, for example by back-reflecting light from an external optical component ( <a href="#">H01S 5/14</a> , <a href="#">H01S 5/4062</a> and <a href="#">H01S 5/4006</a> take precedence ) }
H01S 5/0657	...	{ Mode-locking, i.e. generation of pulses at a frequency corresponding to a roundtrip in the cavity }

- H01S 5/0658 ... { Self-pulsating }
- H01S 5/068 .. Stabilisation of laser output parameters ( [H01S 5/0625](#) takes precedence )
- H01S 5/06804 ... { by monitoring an external parameter, e.g. temperature }
- H01S 5/06808 ... { by monitoring the electrical laser parameters, e.g. voltage or current }
- H01S 5/06812 ... { by monitoring or fixing the threshold current or other specific points of the L-I or V-I characteristics }
- H01S 5/06817 ... { Noise reduction }
- H01S 5/06821 ... { Stabilising other output parameters than intensity or frequency, e.g. phase, polarisation or far-fields }
- H01S 5/06825 ... { Protecting the laser, e.g. during switch-on/off, detection of malfunctioning or degradation }
- H01S 5/0683 ... { by monitoring the optical output parameters }
- H01S 5/06832 .... { Stabilising during amplitude modulation }
- H01S 5/06835 .... { Stabilising during pulse modulation or generation }
- H01S 5/06837 .... { Stabilising otherwise than by an applied electric field or current, e.g. by controlling the temperature }
- H01S 5/0687 .... Stabilising the frequency of the laser
- 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 ) }
- H01S 5/1003 .. { Waveguide having a modified shape along the axis, e.g. branched, curved, tapered, voids }
- H01S 5/1007 ... { Branched waveguides }
- H01S 5/101 ... { Curved waveguide ( [H01S 5/1243](#) takes precedence ) }
- H01S 5/1014 ... { Tapered waveguide, e.g. spotsizer converter ( [H01S 5/1064](#) takes precedence ) }
- H01S 5/1017 ... { Waveguide having a void for insertion of materials to change optical properties }
- H01S 5/1021 .. { Coupled cavities ( [H01S 5/14](#) takes precedence ) }
- H01S 5/1025 .. { Extended cavities }
- H01S 5/1028 .. { Coupling to elements in the cavity, e.g. coupling to waveguides adjacent the active region, e.g. forward coupled (DFC) structures }
- H01S 5/1032 ... { Coupling to elements comprising an optical axis that is not aligned with the optical axis of the active region }
- H01S 5/1035 .... { Forward coupled structures (DFC) }
- H01S 5/1039 .. { Details on the cavity length }
- H01S 5/1042 .. { Optical microcavities, e.g. cavity dimensions comparable to the wavelength }
- H01S 5/1046 .. { Comprising interactions between photons and plasmons, e.g. by a corrugated surface }
- H01S 5/105 .. { Comprising a photonic bandgap structure }
- H01S 5/1053 .. { Comprising an active region having a varying composition or cross section in a specific direction }
- H01S 5/1057 ... { varying composition along the optical axis }
- H01S 5/106 ... { varying thickness along the optical axis }
- H01S 5/1064 ... { varying width along the optical axis }

H01S 5/1067	...	{ comprising nanoparticles }
H01S 5/1071	..	{ Ring-lasers }
H01S 5/1075	...	{ Disk lasers with special modes, e.g. whispering gallery lasers }
H01S 5/1078	..	{ with means to control the spontaneous emission, e.g. reducing or reinjection }
H01S 5/1082	..	{ with a special facet structure, e.g. structured, non planar, oblique }
H01S 5/1085	...	{ Oblique facets }
H01S 5/1089	..	{ Unstable resonators }
H01S 5/1092	..	{ Multi-wavelength lasing }
H01S 5/1096	...	{ in a single cavity }
H01S 5/12	..	the resonator having a periodic structure, e.g. in distributed feed-back lasers (DFB-lasers) ( <a href="#">H01S 5/18</a> takes precedence ) {( forward coupled structures, i.e. DFC lasers, <a href="#">H01S 5/1028</a> )}
H01S 5/1203	...	{ over only a part of the length of the active region }
H01S 5/1206	...	{ having a non constant or multiplicity of periods }
H01S 5/1209	....	{ Sampled grating }
H01S 5/1212	....	{ Chirped grating }
H01S 5/1215	....	{ Multiplicity of periods }
H01S 5/1218	.....	{ in superstructured configuration, e.g. more than one period in an alternate sequence }
H01S 5/1221	...	{ Detuning between Bragg wavelength and gain maximum }
H01S 5/1225	...	{ with a varying coupling constant along the optical axis }
H01S 5/1228	...	{ DFB lasers with a complex coupled grating, e.g. gain or loss coupling }
H01S 5/1231	...	{ Grating growth or overgrowth details }
H01S 5/1234	...	{ Actively induced grating, e.g. acoustically or electrically induced }
H01S 5/1237	...	{ Lateral grating, i.e. grating only adjacent ridge or mesa }
H01S 5/124	...	{ incorporating phase shifts }
H01S 5/1243	....	{ by other means than a jump in the grating period, e.g. bent waveguides }
H01S 5/1246	....	{ plurality of phase shifts }
H01S 5/125	...	Distributed Bragg reflector lasers (DBR-lasers)
H01S 5/14	..	External cavity lasers {( <a href="#">external cavity elements</a> , their control or stabilisation <a href="#">H01S 3/08</a> , <a href="#">H01S 3/10</a> and <a href="#">H01S 3/13</a> )}

**NOTE**

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](#)

H01S 5/141	...	{ using a wavelength selective device, e.g. a grating or etalon ( <a href="#">H01S 5/146</a> takes precedence )}
H01S 5/142	....	{ which comprises an additional resonator }
H01S 5/143	....	{ Littman-Metcalf configuration, e.g. laser - grating - mirror }
H01S 5/145	...	{ Phase conjugate mirrors }
H01S 5/146	...	{ using a fiber as external cavity }
H01S 5/147	....	{ having specially shaped fibre, e.g. lensed or tapered end portion }
H01S 5/148	...	{ using a Talbot cavity }

H01S 5/16	..	Window-type lasers, i.e. with a region of non-absorbing material between the active region and the reflecting surface
H01S 5/162	...	{ with window regions made by diffusion or disordering of the active layer }
H01S 5/164	...	{ with window regions comprising semiconductor material with a wider bandgap than the active layer }
H01S 5/166	...	{ with window regions comprising non-semiconducting materials }
H01S 5/168	...	{ with window regions comprising current blocking layers }
H01S 5/18	..	Surface-emitting lasers (SE-lasers)
H01S 5/183	...	having a vertical cavity (VCSE-lasers)
H01S 5/18302	....	{ comprising an integrated optical modulator }
H01S 5/18305	....	{ with emission through the substrate, i.e. bottom emission }
H01S 5/18308	....	{ having a special structure for lateral current or light confinement }
H01S 5/18311	.....	{ using selective oxidation }
H01S 5/18313	.....	{ by oxidizing at least one of the DBR layers }
H01S 5/18316	.....	{ Airgap confined }
H01S 5/18319	.....	{ comprising a periodical structure in lateral directions ( <a href="#">photonic crystals in semiconductor laser structures per se H01S 5/105</a> ) }
H01S 5/18322	.....	{ Position of the structure }
H01S 5/18325	.....	{ Between active layer and substrate }
H01S 5/18327	.....	{ Structure being part of a DBR ( <a href="#">H01S 5/18391</a> takes precedence ) }
H01S 5/1833	.....	{ with more than one structure }
H01S 5/18333	.....	{ only above the active layer }
H01S 5/18336	.....	{ only below the active layer }
H01S 5/18338	.....	{ Non-circular shape of the structure }
H01S 5/18341	....	{ Intra-cavity contacts }
H01S 5/18344	....	{ characterized by the mesa, e.g. dimensions or shape of the mesa }
H01S 5/18347	.....	{ Mesa comprising active layer }
H01S 5/1835	.....	{ Non-circular mesa }
H01S 5/18352	.....	{ Mesa with inclined sidewall }
H01S 5/18355	....	{ having a defined polarisation }
H01S 5/18358	....	{ containing spacer layers to adjust the phase of the light wave in the cavity }
H01S 5/18361	....	{ Structure of the reflectors, e.g. hybrid mirrors }
H01S 5/18363	.....	{ comprising air layers }
H01S 5/18366	.....	{ Membrane DBR, i.e. a movable DBR on top of the VCSEL }
H01S 5/18369	.....	{ based on dielectric materials }
H01S 5/18372	.....	{ by native oxidation }
H01S 5/18375	.....	{ based on metal reflectors }
H01S 5/18377	.....	{ comprising layers of different kind of materials, e.g. combinations of semiconducting with dielectric or metallic layers }
H01S 5/1838	.....	{ Reflector bonded by wafer fusion or by an intermediate compound }
H01S 5/18383	....	{ with periodic active regions at nodes or maxima of light intensity }
H01S 5/18386	....	{ Details of the emission surface for influencing the near- or far-field, e.g. a grating on the surface }
H01S 5/18388	.....	{ Lenses }

H01S 5/18391	.....	{ Aperiodic structuring to influence the near- or far-field distribution }
H01S 5/18394	.....	{ Apertures, e.g. defined by the shape of the upper electrode }
H01S 5/18397	....	{ Plurality of active layers vertically stacked in a cavity for multi-wavelength emission }
H01S 5/187	...	using a distributed Bragg reflector (SE-DBR-lasers)
H01S 5/20	.	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 5/2004	..	{ Confining in the direction perpendicular to the layer structure }
H01S 5/2009	...	{ electron barrier layers }
H01S 5/2013	....	{ MQW barrier reflection layers }
H01S 5/2018	...	{ Optical confinement, e.g. absorbing-, reflecting- or waveguide-layers }
H01S 5/2022	....	{ Absorbing region or layer parallel to the active layer, e.g. to influence transverse modes }
H01S 5/2027	....	{ Reflecting region or layer, parallel to the active layer, e.g. to modify propagation of the mode in the laser or to influence transverse modes }
H01S 5/2031	....	{ characterized by special waveguide layers, e.g. asymmetric waveguide layers or defined band-gap discontinuities }
H01S 5/2036	..	{ Broad area laserse }
H01S 5/204	..	{ Strongly index guided structures }
H01S 5/2045	...	{ employing free standing waveguides or air gap confinement }
H01S 5/205	..	{ Antiguided structures }
H01S 5/2054	..	{ Methods of obtaining the confinement }
H01S 5/2059	...	{ by means of particular conductivity zones, e.g. obtained by particle bombardment or diffusion }
H01S 5/2063	....	{ obtained by particle bombardment }
H01S 5/2068	....	{ obtained by radiation treatment or annealing }
H01S 5/2072	....	{ obtained by vacancy induced diffusion }
H01S 5/2077	...	{ using lateral bandgap control during growth, e.g. selective growth, mask induced }
H01S 5/2081	...	{ using special etching techniques }
H01S 5/2086	....	{ lateral etch control, e.g. mask induced }
H01S 5/209	....	{ special etch stop layers }
H01S 5/2095	...	{ using melting or mass transport }
H01S 5/22	..	having a ridge or stripe structure
H01S 5/2201	...	{ in a specific crystallographic orientation }
H01S 5/2202	...	{ by making a groove in the upper laser structure }
H01S 5/2203	...	{ with a transverse junction stripe (TJS) structure }
H01S 5/2205	...	{ comprising special burying or current confinement layers }
H01S 5/2206	....	{ based on III-V materials }
H01S 5/2207	.....	{ GaAsP based }
H01S 5/2209	.....	{ GaInP based }
H01S 5/221	.....	{ containing aluminium }



H01S 5/2211	....	{ based on II-VI materials }
H01S 5/2213	....	{ based on polyimide or resin }
H01S 5/2214	....	{ based on oxides or nitrides }
H01S 5/2215	.....	{ using native oxidation of semiconductor layers }
H01S 5/2216	.....	{ nitrides }
H01S 5/2218	....	{ having special optical properties }
H01S 5/2219	.....	{ absorbing }
H01S 5/222	.....	{ having a refractive index lower than that of the cladding layers or outer guiding layers }
H01S 5/2222	....	{ having special electric properties }
H01S 5/2223	.....	{ hetero barrier blocking layers, e.g. P-P or N-N }
H01S 5/2224	.....	{ semi-insulating semiconductors }
H01S 5/2226	.....	{ semiconductors with a specific doping }
H01S 5/2227	.....	{ special thin layer sequence }
H01S 5/2228	.....	{ quantum wells }
H01S 5/223	...	Buried stripe structure { ( <a href="#">H01S 5/227</a> takes precedence ) }
H01S 5/2231	....	{ with inner confining structure only between the active layer and the upper electrode }
H01S 5/2232	....	{ with inner confining structure between the active layer and the lower electrode }
H01S 5/2234	.....	{ having a structured substrate surface }
H01S 5/2235	.....	{ with a protrusion }
H01S 5/2237	....	{ with a non-planar active layer }
H01S 5/2238	....	{ with a terraced structure }
H01S 5/227	...	Buried mesa structure; { Striped active layer }
H01S 5/2272	....	{ grown by a mask induced selective growth }
H01S 5/2275	....	{ mesa created by etching }
H01S 5/2277	.....	{ double channel planar buried heterostructure (DCPBH) laser }
H01S 5/24	..	having a grooved structure, e.g. V-grooved, { crescent active layer in groove, VSIS laser }
H01S 5/30	.	Structure or shape of the active region; Materials used for the active region
H01S 5/3004	..	{ employing a field effect structure for inducing charge-carriers, e.g. FET }
H01S 5/3009	...	{ MIS or MOS configurations }
H01S 5/3013	..	{ A(III)-B(V) compounds }
H01S 5/3018	..	{ A(II)-B(VI) compounds }
H01S 5/3022	..	{ A(IV)-B(VI) compounds }
H01S 5/3027	..	{ IV compounds }
H01S 5/3031	...	{ Si }
H01S 5/3036	.....	{ SiC }
H01S 5/304	.....	{ porous Si }
H01S 5/3045	...	{ diamond }
H01S 5/305	..	{ characterised by the doping materials used in the laser structure }
H01S 5/3054	...	{ p-doping }

H01S 5/3059	....	{ in II-VI materials }
H01S 5/3063	....	{ using Mg }
H01S 5/3068	...	{ deep levels }
H01S 5/3072	...	{ Diffusion blocking layer, i.e. a special layer blocking diffusion of dopants }
H01S 5/3077	...	{ plane dependent doping }
H01S 5/3081	....	{ using amphoteric doping }
H01S 5/3086	...	{ doping of the active layer }
H01S 5/309	....	{ doping of barrier layers that confine charge carriers in the laser structure, e.g. the barriers in a quantum well structure ( <a href="#">Barriers in quantum wells per se H01S 5/3407</a> ) }
H01S 5/3095	...	{ Tunnel junction }
H01S 5/32	..	comprising PN junctions, e.g. hetero- or double- heterostructures ( <a href="#">H01S 5/34</a> , <a href="#">H01S 5/36</a> take precedence )
H01S 5/3201	...	{ incorporating bulkstrain effects, e.g. strain compensation, strain related to polarisation }
H01S 5/3202	...	{ grown on specifically orientated substrates, or using orientation dependent growth }
H01S 5/3203	....	{ on non-planar substrates to create thickness or compositional variations }
H01S 5/3205	...	{ with an active layer having a graded composition in the growth direction }
H01S 5/3206	...	{ ordering or disordering the natural superlattice in ternary or quaternary materials }
H01S 5/3207	....	{ ordered active layer }
H01S 5/3209	....	{ disordered active layer }
H01S 5/321	...	{ having intermediate bandgap layers }
H01S 5/3211	...	{ characterised by special cladding layers, e.g. details on band-discontinuities }
H01S 5/3213	....	{ asymmetric cladding layers }
H01S 5/3214	....	{ comprising materials from other groups of the periodic system than the materials of the active layer, e.g. ZnSe claddings and GaAs active layer }
H01S 5/3215	....	{ graded composition cladding layers }
H01S 5/3216	....	{ quantum well or superlattice cladding layers }
H01S 5/3218	....	{ specially strained cladding layers, other than for strain compensation }
H01S 5/3219	....	{ explicitly Al-free cladding layers }
H01S 5/322	...	{ type-II junctions }
H01S 5/3222	...	{ in A(IV)-B(VI) compounds, e.g. PbSSe-laser }
H01S 5/3223	...	{ IV compounds }
H01S 5/3224	....	{ Si }
H01S 5/3226	.....	{ SiC }
H01S 5/3227	.....	{ porous Si }
H01S 5/3228	....	{ diamond }
H01S 5/323	...	in A(III)-B(V) compounds, e.g. AlGaAs-laser, { InP-based laser }
H01S 5/32308	....	{ emitting light at a wavelength less than 900 nm }
H01S 5/32316	.....	{ comprising only (Al)GaAs }
H01S 5/32325	.....	{ red laser based on InGaP }
H01S 5/32333	.....	{ based on InGaAsP }

H01S 5/32341	.....	{ blue laser based on GaN or GaP }
H01S 5/3235	....	{ emitting light at a wavelength longer than 1000 nm, e.g. InP-based 1300 nm and 1500 nm lasers }
H01S 5/32358	.....	{ containing very small amounts, usually less than 1%, of an additional III or V compound to decrease the band-gap strongly in a non-linear way by the bowing effect }
H01S 5/32366	.....	{ (In)GaAs with small amount of N }
H01S 5/32375	.....	{ In(As)N with small amount of P, or In(As)P with small amount of N }
H01S 5/32383	.....	{ small amount of Thallium (Tl) e.g. GaTlP }
H01S 5/32391	.....	{ based on In(Ga)(As)P }
H01S 5/327	...	in A(II)-B(VI) compounds, e.g. ZnCdSe-laser
H01S 5/34	..	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 5/36 takes precedence )
H01S 5/3401	...	{ having no PN junction, e.g. unipolar lasers, intersubband lasers, quantum cascade lasers }
H01S 5/3402	....	{ intersubband lasers, e.g. transitions within the conduction or valence bands }
H01S 5/3403	...	{ having a strained layer structure in which the strain performs a special function, e.g. general strain effects, strain versus polarisation }
H01S 5/3404	....	{ influencing the polarisation }
H01S 5/3406	....	{ including strain compensation }
H01S 5/3407	...	{ characterised by special barrier layers }
H01S 5/3408	...	{ characterised by specially shaped wells, e.g. triangular }
H01S 5/3409	...	{ special GRINSCH structures }
H01S 5/341	...	{ Structures having reduced dimensionality, e.g. quantum wires }
H01S 5/3412	....	{ quantum box or quantum dash }
H01S 5/3413	...	{ comprising partially disordered wells or barriers }
H01S 5/3414	....	{ by vacancy induced interdiffusion }
H01S 5/3415	...	{ containing details related to carrier capture times into wells or barriers }
H01S 5/3416	....	{ tunneling through barriers }
H01S 5/3418	...	{ using transitions from higher quantum levels }
H01S 5/3419	....	{ intersubband lasers, e.g. laser transitions within the conduction or valence bands in non unipolar structures }
H01S 5/342	...	{ containing short period superlattices (SPS) }
H01S 5/3421	...	{ layer structure of quantum wells to influence the near/far field }
H01S 5/3422	...	{ comprising type-II quantum wells or superlattices }
H01S 5/3424	...	{ comprising freestanding wells }
H01S 5/3425	...	{ comprising coupled wells or superlattices }
H01S 5/3426	...	{ in A(IV)-B(VI) compounds, e.g. PbSSe-laser }
H01S 5/3427	...	{ in IV compounds }
H01S 5/3428	...	{ layer orientation perpendicular to the substrate }
H01S 5/343	...	in A(III)-B(V) compounds, e.g. AlGaAs-laser, { InP-based laser }
H01S 5/34306	....	{ emitting light at a wavelength longer than 1000nm, e.g. InP based 1300

- and 1500nm lasers }
- H01S 5/34313 . . . . { with a well layer having only As as V-compound, e.g. AlGaAs, InGaAs }
- H01S 5/3432 . . . . . { the whole junction comprising only (Al)GaAs }
- H01S 5/34326 . . . . { with a well layer based on InGa(Al)P, e.g. red laser }
- H01S 5/34333 . . . . { with a well layer based on Ga(In)N or Ga(In)P, e.g. blue laser }
- H01S 5/3434 . . . . { with a well layer comprising at least both As and P as V-compounds }
- H01S 5/34346 . . . . { characterised by the materials of the barrier layers }
- H01S 5/34353 . . . . . { based on (Al)GaAs }
- H01S 5/3436 . . . . . { based on InGa(Al)P }
- H01S 5/34366 . . . . . { based on InGa(Al)AS }
- H01S 5/34373 . . . . . { based on InGa(Al)AsP }
- H01S 5/3438 . . . . . { based on In(Al)P }
- H01S 5/34386 . . . . . { explicitly Al-free }
- H01S 5/34393 . . . . . { not only based on A(III)-B(V) compounds }
- H01S 5/347 . . . in A(II)-B(VI) compounds, e.g. ZnCdSe- laser
- H01S 5/36 . . comprising organic materials ( dye lasers [H01S 3/213](#) )
- H01S 5/40 . Arrangement of two or more semiconductor lasers, not provided for in groups [H01S 5/02](#) to [H01S 5/30](#) ( [H01S 5/50](#) takes precedence )
- H01S 5/4006 . . { Injection locking }
- H01S 5/4012 . . { Beam combining, e.g. by the use of fibres, gratings, polarisers, prisms }
- H01S 5/4018 . . { Lasers electrically in series }
- H01S 5/4025 . . { Array arrangements, e.g. constituted by discrete laser diodes or laser bar ( [H01S 5/42](#) takes precedence ) }
- H01S 5/4031 . . . { Edge-emitting structures }
- H01S 5/4037 . . . . { with active layers in more than one orientation }
- H01S 5/4043 . . . . { with vertically stacked active layers }
- H01S 5/405 . . . . . { Two-dimensional arrays }
- H01S 5/4056 . . . . { emitting light in more than one direction }
- H01S 5/4062 . . . . { with an external cavity or using internal filters, e.g. Talbot filters }
- H01S 5/4068 . . . . { with lateral coupling by axially offset or by merging waveguides, e.g. Y-couplers }
- H01S 5/4075 . . . { Beam steering }
- H01S 5/4081 . . . { Near-or far field control }
- H01S 5/4087 . . . { emitting more than one wavelength }
- H01S 5/4093 . . . . { Red, green and blue [RGB] generated directly by laser action or by a combination of laser action with nonlinear frequency conversion }
- H01S 5/42 . . Arrays of surface emitting lasers
- H01S 5/423 . . . { having a vertical cavity }
- H01S 5/426 . . . . { Vertically stacked cavities }
- H01S 5/50 . Amplifier structures not provided for in groups [H01S 5/02](#) to [H01S 5/30](#) ( as repeaters in transmission systems [H04B 10/17](#) )
- H01S 5/5009 . . { the arrangement being polarisation-insensitive }

- H01S 5/5018 . . . { using two or more amplifiers or multiple passes through the same amplifier }
- H01S 5/5027 . . { Concatenated amplifiers, i.e. amplifiers in series or cascaded }
- H01S 5/5036 . . { the arrangement being polarisation-selective }
- H01S 5/5045 . . { the arrangement having a frequency filtering function }
- H01S 5/5054 . . { in which the wavelength is transformed by non-linear properties of the active medium, e.g. four wave mixing }
- H01S 5/5063 . . { operating above threshold }
- H01S 5/5072 . . . { Gain clamping, i.e. stabilisation by saturation using a further mode or frequency }
- H01S 5/5081 . . { specifically standing wave amplifiers }
- H01S 5/509 . . { Wavelength converting amplifier, e.g. signal gating with a second beam using gain saturation }

## **H01S 2301/00 Functional characteristics**

- H01S 2301/02 . ASE ( **amplified spontaneous emission** ), noise; Reduction thereof
- H01S 2301/03 . Suppression of nonlinear conversion, e.g. specific design to suppress for example stimulated brillouin scattering [SBS], mainly in optical fibres in combination with multimode pumping
- H01S 2301/04 . Gain spectral shaping, flattening
- H01S 2301/06 . Gain non-linearity, distortion; Compensation thereof
- H01S 2301/08 . Generation of pulses with special temporal shape or frequency spectrum
- H01S 2301/085 . . solitons
- H01S 2301/14 . Semiconductor lasers with special structural design for lasing in a specific polarisation mode
- H01S 2301/145 . . TM polarisation
- H01S 2301/16 . Semiconductor lasers with special structural design to influence the modes, e.g. specific multimode
- H01S 2301/163 . . Single longitudinal mode
- H01S 2301/166 . . Single transverse or lateral mode
- H01S 2301/17 . Semiconductor lasers comprising special layers
- H01S 2301/173 . . The laser chip comprising special buffer layers, e.g. dislocation prevention or reduction
- H01S 2301/176 . . Specific passivation layers on surfaces other than the emission facet
- H01S 2301/18 . Semiconductor lasers with special structural design for influencing the near- or far-field
- H01S 2301/185 . . for reduction of Astigmatism
- H01S 2301/20 . Lasers with a special output beam profile or cross section, e.g. non-Gaussian
- H01S 2301/203 . . with at least one hole in the intensity distribution, e.g. annular or doughnut mode
- H01S 2301/206 . . Top hat profile

**H01S 2302/00**      **Amplification / lasing wavelength****NOTE**

In group [H01S 2302/00](#) and separated therefrom by a + sign the wavelength in nanometers (nnnn) is indicated.

- [H01S 2302/02](#)      . THz - lasers, i.e. lasers with emission in the wavelength range of typically 0.1 mm to 1 mm

**H01S 2303/00**      **Pumping wavelength****NOTE**

In group [H01S 2303/00](#) and separated therefrom by a + sign the wavelength in nanometers (nnnn) is indicated.

**H01S 2304/00**      **Special growth methods for semiconductor lasers**

- [H01S 2304/02](#)      . MBE
- [H01S 2304/025](#)      . . MOMBE
- [H01S 2304/04](#)      . MOCVD or MOVPE
- [H01S 2304/06](#)      . LPE
- [H01S 2304/10](#)      . CBE
- [H01S 2304/12](#)      . Pendeo epitaxial lateral overgrowth [ELOG], e.g. for growing GaN based blue laser diodes