2008

1. D. J. H. C. Maas, A. R. Bellancourt, M. Hoffmann, B. Rudin, Y. Barbarin, M. Golling, T. Südmeyer, and U. Keller, "Growth parameter optimization for fast quantum dot SESAMs", Opt. Express **16**, 18646-18656 (2008)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?uri=oe-16-23-18646
Digital Object Identifier:
10.1364/OE.16.018646

2. M. Hoffmann, Y. Barbarin, D. J. H. C. Maas, M. Golling, I. L. Krestnikov, S. S. Mikhrin, A. R. Kovsh, T. Südmeyer and U. Keller, "Modelocked quantum dot vertical external cavity surface emitting laser", Applied Physics B: Lasers and Optics**,** Volume 93, Number 4 / December, 2008, ISSN: 0946-2171
Link: http://www.springerlink.com/content/7xw1323hv4h1676m/?p=a942212aa9914f37a55309ada34e3c4f&pi=8 (open access)
Abstract:
We report the first successful modelocking of a vertical external cavity surface emitting laser (VECSEL) with a quantum dot (QD) gain region. The VECSEL has a total of 35 QD-layers with an emission wavelength of about 1060 nm. In SESAM modelocked operation, we obtain an average output power of 27.4 mW with 18-ps pulses at a repetition rate of 2.57 GHz. This QD-VECSEL is used as-grown on a 450 µm thick substrate, which limits the average output power.
Digital Object Identifier:
10.1007/s00340-008-3267-0

3. B. Rudin, A. Rutz, M. Hoffmann, D. J. H. C. Maas, A.-R. Bellancourt, E. Gini, T. Südmeyer, and U. Keller, "Highly efficient optically pumped vertical-emitting semiconductor laser with more than 20 W average output power in a fundamental transverse mode", Optics Letters, Vol. 33, Issue 22, pp. 2719-2721 (2008)
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ol-33-22-2719
Abstract:
We have demonstrated an optically pumped vertical external cavity surface emitting laser (OP-VECSEL) generating more than 20 W of continuous-wave output power in a fundamental transverse mode ($M^2 \approx 1.1$) at 960 nm. The laser is highly efficient with a slope efficiency of 49%, a pump threshold of 4.4 W and an overall optical-to-optical efficiency of 43%.
Digital Object Identifier:
10.1364/OL.33.002719

2009

4. J. Rautiainen, O. G. Okhotnikov, David Eger, S.A. Zolotovskaya, K.A. Fedorova, E.U. Rafailov, “Intracavity generation of 610 nm light by periodically poled near-stoichiometric lithium tantalite”, Electronics Letters, Volume 45, Issue 3, January 29 2009, Page(s):177 - 179
Link: http://ieeexplore.ieee.org/Xplore/login.jsp?url=/stamp/stamp.jsp?arnumber=4770467&isnumber=4770438
Abstract:
Intracavity frequency doubling of an optically pumped GaInNAs semiconductor disk laser by a periodically poled near-stoichiometric lithium tantalate crystal has been investigated. Stable second-harmonic generation at 610 nm has been achieved with an output power of 730 mW, limited only by the spectral acceptance range and Fresnel losses of the crystal. Spectral tuning of 8 nm was realised with a Fabry-Perot etalon.
Digital Object Identifier:
10.1049/el:20093123

5. A.-R. Bellancourt, D.J.H.C. Maas, B. Rudin, M. Golling, T. Südmeyer, and U. Keller, “Modelocked integrated external-cavity surface emitting laser”, IET Optoelectronics, April 2009, Volume 3, Issue 2, p. 61-72
Link: http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=IOEPBG000003000002000061000001&idtype=cvips&gifs=Yes
Abstract:
A modelocked integrated external-cavity surface emitting laser (MIXSEL) is a novel type of ultrafast semiconductor laser, which integrates a saturable absorber directly into a vertical external cavity surface-emitting laser (VECSEL). We discuss the saturable absorber requirements and integration challenges to obtain self-starting and stable pulse formation. One single quantum dot absorber layer was optimized for this application. Since the first feasibility demonstration of an optically pumped MIXSEL, we have further improved the average output power to 185 mW with 32-ps pulses at around 3 GHz pulse repetition rate at a center wavelength of ≈957 nm. We analyze and discuss the challenges for further power scaling and pulse shortening. The MIXSEL concept appears suitable for cost-efficient wafer-scale mass-production when the external cavity is defined by a transparent wafer into which the curved output coupler can be etched. The semiconductor MIXSEL structure would then be glued to such a transparent wafer. The potential for electrically pumped MIXSELs will make this laser technology even more attractive.
Digital Object Identifier:
10.1049/iet-opt.2008.0038

6. M. Butkus, K. G. Wilcox, J. Rautiainen, O. G. Okhotnikov, S. S. Mikhrin, I. L. Krestnikov, A. R. Kovsh, M. Hoffmann, T. Südmeyer, U. Keller, and E. U. Rafailov, “High-power quantum-dot-based semiconductor disk laser”, Optics Letters Vol. 34, Iss. 11, pp. 1672–1674 (2009)
Link: http://www.opticsinfobase.org/ol/abstract.cfm?uri=ol-34-11-1672
Abstract:

We demonstrate multi-watt continuous wave output power from an optically-pumped quantum dot semiconductor disk laser. A continuous wave output power of 4.35 W, with 22 % slope efficiency was demonstrated at a centre wavelength of 1032 nm. This represents a 15 times increase in power, and 10 times increase in slope efficiency from the previously published result using Stranski-Krastanow grown quantum dots. An intra-cavity diamond heat spreader was used for thermal management. The maximum output power was limited by the available pump power and no sign of thermal rollover was observed.
Digital Object Identifier:
10.1364/OL.34.001672

7. Keith G. Wilcox, Mantas Butkus, Ian Farrer, David A. Ritchie, Anne Tropper, and Edik U. Rafailov, "Subpicosecond quantum dot saturable absorber mode-locked semiconductor disk laser", Appl. Phys. Lett. 94, 251105 (2009)
Link:
http://scitation.aip.org/getpdf/servlet/GetPDFServlet?filetype=pdf&id=APPLAB000094000025251105000001&idtype=cvips&prog=normal&subid=APPLAB
Abstract:
We report the generation of sub-picosecond pulses from a passively mode-locked, optically pumped quantum well semiconductor disk laser using a quantum dot semiconductor saturable absorber mirror. We obtained 870-fs pulses at a repetition rate of 895 MHz with average output power of 45 mW at 1027.5 nm. The pulse duration was insensitive to SESAM temperature over the range -10 to 85 0C, with the pulse duration variation caused only by the temperature induced variation in group delay dispersion.
Digital Object Identifier:
10.1063/1.3158960

8. Zolotovskaya, S.A. Wilcox, K.G. Abdolvand, A. Livshits, D.A. and Rafailov, E.U. "Electronically Controlled Pulse Duration Passively Mode-Locked Cr:Forsterite Laser", Photonics Technology Letters, IEEE Vol. 21, Iss 16, pp. 1124-1126 (2009)
Link:
http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?isnumber=5173590&arnumber=5061886&count=23&index=7
Abstract:
A passive mode-locked Cr:forsterite laser with electronically controlled pulse duration is demonstrated. A DC voltage controlled p-n junction quantum-dot semiconductor saturable absorber mirror is presented. Output pulse durations varying from 17.4 to 6.4 ps were obtained by applying a DC voltage between 0 and -4.5 V. No dispersion compensation was used.
Digital Object Identifier:
10.1109/LPT.2009.2023225

9. H. P. Porte, P. Uhd Jepsen, N. Daghestani, E. U. Rafailov, and D. Turchinovich. “Ultrafast release and capture of carriers in InGaAs/GaAs quantum dots observed by time-resolved terahertz spectroscopy”, Applied Physics Letters, 94, 262104 (2009)
Link:
http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=APPLAB000094000026262104000001&idtype=cvips&gifs=yes
Abstract:
We observe ultrafast release and capture of charge carriers in InGaAs/GaAs quantum dots in a room-temperature optical pump-terahertz probe experiment sensitive to the population dynamics of conducting states. In case of resonant excitation of the quantum dot ground state, the maximum conductivity is achieved at approximately 35 ps after photoexcitation, which is assigned to release of carriers from the quantum dots. When exciting carriers into the conduction band of the barriers, depletion of the conductivity via carrier capture into the quantum dots with a few picosecond pump fluence-dependent time constant was observed.
Digital Object Identifier:
10.1063/1.3158958

10. G. Filippidis, E.J. Gualda, M. Mari, K. Troulinaki, C. Fotakis, N. Tavernarakis. “*In vivo* imaging of cell morphology and cellular processes in Caenorhabditis elegans, using non-linear phenomena”, Micron Volume 40 (2009), Issue 8, Pages 876-880
Link: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T9N-4WK4SJV-1&_user=1669875&_coverDate=12%2F31%2F2009&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_searchStrId=1232801414&_rerunOrigin=google&_acct=C000054131&_version=1&_urlVersion=0&_userid=1669875&md5=e2afe3aaf37d5ecde6196a2475917a0e
(Because the link is too long, to get to the paper, copy and paste the link to internet explorer search path).
Abstract:
We present the detailed imaging of structures and processes of the nematode Caenorhabditis elegans (C. elegans) using non-linear microscopy. Complementary information about the anatomy of the nematode was collected by implementing a combination of two photon excitation fluorescence (TPEF), second and third harmonic generation (SHG and THG) image contrast modes on the same microscope. Three-dimensional (3D) reconstructions of TPEF, SHG and THG images were also performed. Moreover, THG imaging technique has been tested as a potential, novel, non-destructive diagnostic tool for monitoring cellular processes in vivo, such as neuronal degeneration.
Digital Object Identifier:
10.1016/j.micron.2009.06.005

2010

11. A.A. Lagatsky, C.G. Leburn, C.T.A. Brown, W. Sibbett, S.A. Zolotovskaya, E.U. Rafailov, "Ultrashort-pulse lasers passively mode locked by quantum-dot-based saturable absorbers", Progress in Quantum Electronics, Volume 34, Issue 1, Pages 1-46 (January 2010)
Link: http://www.sciencedirect.com/science/issue/5308-2010-999659998-1578764
Abstract:
Some key recent achievements in the development of novel saturable absorbers that are based on semiconductor quantum-dot (QD) structures for the passive mode locking of near-infrared lasers are outlined. These are group IV–VI semiconductor nanoparticles (quantum dots) in glass matrices and self-assembled semiconductor quantum dots (group III–V) grown on semiconductor mirrors (QD-SESAMs). The performance of solid-state (Yb^{3+}, Nd^{3+} and Cr^{4+}-based), Yb-doped fibre and monolithically integrated semiconductor lasers has been described within the context of ultrashort-pulse generation using these types of QD-based modulators. Particular attention has been paid to the nonlinear parameters of the QD-based saturable absorbers that determine the quality of the mode locking in such laser systems.
Digital Object Identifier:
10.1016/j.pquantelec.2009.11.001

12. Susana I. C. O. Santos, Manoj Mathew, and Pablo Loza-Alvarez, "Real time imaging of femtosecond laser induced nano-neurosurgery dynamics in C. elegans", Opt. Express **18**, 364-377 (2010)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?uri=oe-18-1-364
Abstract:
In this study we present for the first time the use of confocal microscopy and laser scanning bright field microscopy (LSBF) for real time imaging of femtosecond laser nanosurgery and its dynamics in *C. elegans*. A single multimodal optical workstation that provides the ability to perform femtosecond laser nanosurgery and simultaneous confocal and LSBF imaging was used for the purpose. With this tool several dynamic phenomena concomitant with laser nanosurgery in *C. elegans* were observed and imaged. Some of these dynamic phenomena, like muscular contraction and single muscle cell stimulation, have been imaged for the first time during nano-neurosurgery of *C. elegans*.
Digital Object Identifier:
10.1364/OE.18.000364

13. S. Breuer, W. Elsäßer, and M. Hopkinson, "State-Switched Mode Locking of a Two-Segment Quantum Dot Laser via a Self-Electro-Optical Quantum Dot Absorber", Electron. Lett. -- 21 January 2010 -- Volume 46, Issue 2, p.161–162
Link:
http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=ELLEAK000046000002000161000001&idtype=cvips&gifs=yes&ref=no
Abstract:

A new functionality of a quantum dot self-electro-optical absorber is demonstrated. External resistor tuning of a quantum dot absorber via the quantum-confined Stark effect in a strongly chirped broadband two-section quantum dot laser configuration allows tuning from the modelocked ground state emission at 1270 nm to the excited state emission at 1207 nm with decreasing resistance.
Digital Object Identifier:
10.1049/el.2010.3360

14. Jussi Rautiainen, Ksenia A. Fedorova, Jari Nikkinen, David Eger, Ville-Markus Korpijärvi, Edik U. Rafailov, and Oleg G. Okhotnikov, "1.2-μm Semiconductor Disk Laser Frequency Doubled With Periodically Poled Lithium Tantalate Crystal", IEEE PHOTONICS TECHNOLOGY LETTERS, Vol. 22, No. 7, April 1, 2010 p. 453-455
Link: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5401102
Abstract:
In this letter, we demonstrate an optically pumped semiconductor disk laser frequency doubled with a periodically poled lithium tantalate crystal. Crystals with various lengths were tested for intracavity frequency conversion. The semiconductor disk laser exploited GaInNAs-based active region with GaAs–AlAs distributed Bragg mirror to produce emission at 1.2-μm wavelength. The frequency doubled power up to 760 mW at the wavelength of 610 nm was achieved with a 2-mm-long crystal.
Digital Object Identifier:
10.1109/LPT.2010.2040989

15. Jussi Rautiainen, Igor Krestnikov, Mantas Butkus, Edik U. Rafailov, and Oleg G. Okhotnikov, "Optically pumped semiconductor quantum dot disk laser operating at 1180 nm," Opt. Lett. 35, 694-696 (2010)
Link:http://www.opticsinfobase.org/ol/abstract.cfm?URI=ol-35-5-694
Abstract:
We demonstrate an optically-pumped semiconductor disk laser based on Stranski-Krastanov self assembled InGaAs quantum dot gain medium. The gain region incorporating 39 quantum dot layers for 1180 nm emission is grown on the GaAs/AlAs distributed Bragg reflector and is bonded onto an intracavity diamond heat spreader. We achieved 1.75 W single-transverse-mode output with circular beam (M^2<1.2).
Digital Object Identifier:
10.1364/OL.35.000694

16. Marco Vallone, "Many-body formulation of carriers capture time in quantum dots applicable in device simulation codes" Appl. Physics, vol. 107, 053718 (2010)
Link:http://link.aip.org/link/?JAP/107/053718

Abstract:
We present an application of Green's functions formalism to calculate in a simplified but rigorous way electrons and holes capture time in quantum dots in closed form as function of carrier density, levels confinement potential, and temperature. Carrier-carrier (Auger) scattering and single LO-phonon emission are both addressed accounting for dynamic effects of the potential screening in the single plasmon pole approximation of the dielectric function. Regarding the LO-phonons interaction, the formulation evidences the role of the dynamic screening from wetting-layer carriers in comparison with its static limit, describes the interplay between screening and Fermi band filling, and offers simple expressions for capture time, suitable for modelling implementation.
Digital Object Identifier:
10.1063/1.3309838

17. A. E. H. Oehler, M. C. Stumpf, S. Pekarek, T. Südmeyer, K. J. Weingarten and U. Keller, "Picosecond diode-pumped 1.5 μm Er,Yb:glass lasers operating at 10–100 GHz repetition rate", Journal Applied Physics B: Lasers and Optics, Issue Volume 99, Numbers 1-2 / April, 2010
Abstract:
Stable ultrafast laser sources at multi-GHz repetition rates are important for various application areas, such as optical sampling, frequency comb metrology, or advanced high-speed return-to-zero telecom systems. We review SESAM-mode-locked Er,Yb:glass lasers operating in the 1.5 μm spectral region at multi-GHz repetition rates, discussing the key improvements that have enabled increasing the repetition rate up to 100 GHz. We also present further improved results with shorter pulse durations from a 100 GHz Er,Yb:glass laser. With an improved SESAM design we achieved 1.1 ps pulses with up to 30 mW average output power. Moreover, we discuss for the first time the importance of beam quality deteriorations arising from frequency-degenerate higher order spatial modes in such lasers.
Digital Object Identifier:
10.1007/s00340-010-3912-2

18. Martin Hoffmann, Oliver D. Sieber, Deran J. H. C. Maas, Valentin J. Wittwer, Matthias Golling, Thomas Südmeyer, and Ursula Keller, "Experimental verification of soliton-like pulse-shaping mechanisms in passively mode-locked VECSELs," Opt. Express Vol 18, Issue 10, pp 10143-10153 (2010)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?URI=oe-18-10-10143
Abstract:
We present a detailed experimental study on the influence of dispersion on the pulse formation in passively modelocked vertical-external-cavity surface-emitting lasers (VECSELs). We have demonstrated that the shortest pulse duration requires slightly positive dispersion to balance the nonlinear phase shift induced by strong semiconductor gain and absorber saturation. This is in contrast to soliton modelocking in ion-doped solid-state lasers – but similarities remain and will be discussed. Our results are in good qualitative agreement with numerical simulations and confirm the quasi-soliton mode locking mechanism of ultrafast VECSELs.

Digital Object Identifier:
10.1364/OE.18.010143

19. Jussi Rautiainen, Igor Krestnikov, Jari Nikkinen, and Oleg G. Okhotnikov, “2.5 W orange power by frequency conversion from a dual-gain quantum-dot disk laser” Opt. Lett. Vol. 35, No. 12, 1935-1937 (2010)
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ol-35-12-1935
Abstract:
We report a disk laser using two quantum-dot semiconductor gain elements, resulting in what we believe is the first demonstration of intracavity frequency conversion with these active media. Output power of 6W has been obtained in dual-gain configuration at a wavelength of 1180nm, while single-gain lasers produced up to 3 and 4W individually, limited by thermal rollover in the output characteristics. The gain enhancement achieved with two active elements comprising 39 layers of Stranski–Krastanov InGaAs quantum dots allows for intracavity frequency doubling delivering 2.5W of orange radiation.
Digital Object Identifier:
10.1364/OL.35.001935

20. Charis Mesaritakis, Christos Simos, Hercules Simos, Spiros Mikroulis, Igor Krestnikov, Dimitris Syvridis, “Pulse width narrowing due to dual ground state emission in quantum dot passively mode locked lasers”, Appl. Phys. Lett. 96, 211110 (2010)
Link: http://apl.aip.org/applab/v96/i21/p211110_s1
Abstract:
We present an experimental investigation of the emission properties of a multisection InGaAs quantum dot passively mode locked laser under dual waveband emission from the ground state (GS). A mode locking regime directly related to the GS splitting has been depicted. It is related to significant pulse width decrease with increasing injection current under dual peak emission from the GS, leading to generation of pulses with increased peak power with respect to the usual device operation.
Digital Object Identifier:
10.1063/1.3432076

21. Maria Ana Cataluna, Daniil I. Nikitichev, Spiros Mikroulis, Hercules Simos, Christos Simos, Charis Mesaritakis, Dimitris Syvridis, Igor Krestnikov, Daniil Livshits, and Edik U. Rafailov, “Dual-wavelength mode-locked quantum-dot laser, via ground and excited state transitions: experimental and theoretical investigation”, Optics Express, Vol. 18, Issue 12, pp. 12832-12838 (2010)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?URI=oe-18-12-12832
Abstract:

We report a dual-wavelength passive mode locking regime where picosecond pulses are generated from both ground (λ = 1263nm) and excited state transitions (λ = 1180nm), in a GaAs-based monolithic two-section quantum-dot laser. Moreover, these results are reproduced by numerical simulations which provide a better insight on the dual-wavelength mode-locked operation.
Digital Object Identifier:
10.1364/OE.18.012832

22. Sotiris Psilodimitrakopoulos, Ivan Amat-Roldan, Pablo Loza-Alvarez and David Artigas, “Estimating the helical pitch angle of amylopectin in starch using polarization second harmonic generation microscopy”, Journal of Optics, Volume 12, Number 8
Link: http://iopscience.iop.org/2040-8986/12/8/084007
Abstract:
Starch granules are among the brightest natural second harmonic generation (SHG) converters. They basically consist of amylose and amylopectin molecules and the source of the SHG signal is still undetermined. In the present study we perform polarization sensitive SHG (PSHG) imaging of wheat starch granules and we fit the SHG signal variation of each pixel of the PSHG images into a generalized biophysical model. By assuming that the SHG source molecule is a helix with cylindrical symmetry along its long axis, the model extracts the helical pitch angle of the SHG source for every pixel of the image. By displaying the pixel histogram representing this helical pitch angle we found a highly peaked histogram with maximum at θe = 36.1° and a width of Δθe = 9.3°. This pitch angle corresponds to the strand of the parallel double helical structure, called amylopectin (as measured by a small angle x-ray scattering technique). This demonstrates amylopectin (and not amylose) as the source of SHG in starch. According to our knowledge, this is the first estimation of the amylopectin's pitch angle in starch using PSHG.
Digital Object Identifier:
10.1088/2040-8978/12/8/084007

23. Rodrigo Aviles-Espinosa, Susana I. C. O. Santos, Andreas Brodschelm, Wilhelm G. Kaenders, Cesar Alonso-Ortega, David Artigas, and Pablo Loza-Alvarez, “Third-harmonic generation for the study of Caenorhabditis elegans embryogenesis”, J. Biomed. Opt., Vol. 15, 046020 (2010)
Link: http://spiedl.aip.org/getpdf/servlet/GetPDFServlet?filetype=pdf&id=JBOPFO000015000004046020000001 (open access)
Abstract:
Live microscopy techniques (i.e., differential interference contrast, confocal microscopy, etc.) have enabled the understanding of the mechanisms involved in cells and tissue formation. In long-term studies, special care must be taken in order to avoid sample damage, restricting the applicability of the different microscopy techniques. We demonstrate the potential of using third-harmonic generation (THG) microscopy for morphogenesis/embryogenesis studies in living Caenorhabditis elegans (C. elegans). Moreover, we show that the THG signal is obtained in all the embryo development stages, showing different tissue/structure information. For this research, we employ a 1550-nm femtosecond fiber laser and demonstrate that the expected water absorption at this wavelength does not severely compromise sample viability.

Additionally, this has the important advantage that the THG signal is emitted at visible wavelengths (516 nm). Therefore, standard collection optics and detectors operating near maximum efficiency enable an optimal signal reconstruction. All this, to the best of our knowledge, demonstrates for the first time the noninvasiveness and strong potential of this particular wavelength to be used for high-resolution four-dimensional imaging of embryogenesis using unstained C. elegans in vivo samples.
Digital Object Identifier:
10.1117/1.3477535

24. Stefan Breuer, Mattia Rossetti, Wolfgang Elsässer, Lukas Drzewietzki, Paolo Bardella, Ivo Montrosset, Michel Krakowski, and Mark Hopkinson, “Reverse-emission-state-transition mode locking of a two-section InAs/InGaAs quantum dot laser”, Appl. Phys. Lett. 97, 071118 (2010)
Link: http://link.aip.org/link/APPLAB/v97/i7/p071118/s1
Abstract:
Reverse-emission-state-transition mode locking in a two-section InAs/InGaAs quantum dot laser is experimentally investigated and confirmed by simulations. Stable mode locking starts on the first excited state (λ = 1207 nm) and then, with increasing gain current, a transition to stable simultaneous two-state mode locking on excited state and ground state (λ = 1270 nm) takes place. This particular state-transition occurs already at 0 V reverse-bias and at moderate gain-section currents. It is attributed to the strong active region chirping of the gain medium and in particular to a photon pumping process in the saturable absorber section.
Digital Object Identifier:
10.1063/1.3480405

25. Ksenia A. Fedorova, Maria Ana Cataluna, Igor Krestnikov, Daniil Livshits, and Edik U. Rafailov, "Broadly tunable high-power InAs/GaAs quantum-dot external cavity diode lasers," Opt. Express 18, 19438-19443 (2010)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?URI=oe-18-18-19438
Abstract:
A record broadly tunable high-power external cavity InAs/GaAs quantum-dot diode laser with a tuning range of 202 nm (1122 nm-1324 nm) is demonstrated. A maximum output power of 480 mW and a side-mode suppression ratio greater than 45 dB are achieved in the central part of the tuning range. We exploit a number of strategies for enhancing the tuning range of external cavity quantum-dot lasers. Different waveguide designs, laser configurations and operation conditions (pump current and temperature) are investigated for optimization of output power and tunability.
Digital Object Identifier:
10.1364/OE.18.019438

26. M.A. Cataluna, D.B. Malins, A. Gomez-Iglesias, W. Sibbett, A Miller, and E. U. Rafailov, "Temperature dependence of electroabsorption dynamics in an InAs quantum-dot saturable absorber at 1.3μm and its impact on mode-locked quantum-dot lasers", Applied Physics Letters Volume 97, Issue 12 (2010)
Link: http://link.aip.org/link/?APL/97/121110
Abstract:
We report temperature-dependent absorption recovery times in an InAs *p-i-n* ridge waveguide quantum dot modulator under low reverse bias, investigated via sub-picosecond pumpprobe measurements. The measured decrease in absorption recovery time with increasing temperature (293K-319K) is in excellent agreement with a thermionic emission model. A similar trend in pulse duration with increasing temperature is also observed from a two-section modelocked quantum-dot laser fabricated from a similar epitaxial structure. These measurements confirm the key role of the absorber recovery time in the reduction of the pulses generated by two-section mode-locked quantum-dot lasers, both at room and elevated temperatures.
Digital Object Identifier:
10.1063/1.3489104

27. Y. Ding, D.I. Nikitichev, I. Krestnikov, D. Livshits, M.A. Cataluna and E.U. Rafailov, "Quantum-dot external-cavity passively modelocked laser with high peak power and pulse energy", Electronics Letters, Volume 46, No.22 (2010)
Link: http://dx.doi.org/10.1049/el.2010.2336
Abstract:
An InAs quantum-dot external-cavity passively modelocked laser with an operation wavelength of 1.27 mm is demonstrated, based on a twosection quantum-dot superluminescent diode with bending ridge waveguide and a 96% output coupler. Stable modelocking with an average power up to 60 mW was obtained at a repetition frequency of 2.4 GHz. This performance corresponds to a 25 pJ pulse energy obtained directly from the oscillator, which represents a 55-fold increase in pulse energy when compared to the current state-of-the-art for semiconductor lasers. At a repetition frequency of 1.14 GHz, picosecond optical pulses with 1.5 W peak power are also demonstrated, representing the highest peak power achieved from an external-cavity laser at the 1.3 mm waveband, without the use of any pulse compression or optical amplification.
Digital Object Identifier:
doi:10.1049/el.2010.2336

28. M. C. Hoffmann, B. S. Monozon, D. Livshits, E. U. Rafailov, and D. Turchinovich, "Terahertz electro-absorption effect enabling femtosecond all-optical switching in semiconductor quantum dots", Applied Physics Letters, Volume 97 Issue 23 (2010)
Link: http://apl.aip.org/resource/1/applab/v97/i23/p231108_s1
Abstract:

We demonstrate an instantaneous all-optical manipulation of optical absorption in InGaAs/GaAs quantum dots (QDs) via an electro-absorption effect induced by the electric field of an incident free-space terahertz signal. A terahertz signal with the full bandwidth of 3 THz was directly encoded onto an optical signal probing the absorption in QDs, resulting in the encoded temporal features as fast as 460 fs. The instantaneous nature of this effect enables femtosecond all-optical switching at very high repetition rates, suggesting applications in terahertz-range wireless communication systems with data rates of at least 0.5 Tbit/s.

Digital Object Identifier:
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2011

29. M.Rossetti, P.Bardella, I.Montrosset, “Time-domain Travelling-wave Model for Quantum Dot Passive Mode-locked Lasers”, IEEE Journal of Quantum Electronics, Volume 47 No.2 (2011)
Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5679844
Abstract: We present a time-domain travelling-wave model for the simulation of passive mode-locking in quantum dot (QD) lasers; accurate expressions for the time varying QD optical susceptibility and the QD spontaneous emission noise source are introduced in the 1-D wave equations and numerically described using a set of infinite-impulse response filters. The inhomogeneous broadening of the density of states of the whole QD ensemble as well as the homogeneous linewidth of each QD interband transition are properly taken into account in the model. Population dynamics in the QD, quantum well, and barrier states under both forward and reverse bias conditions are modeled via proper sets of multi-population rate equations coupled with the field propagation equations. The model is first applied to the study of gain and absorption recovery in a QD semiconductor optical amplifier under both forward and reverse bias conditions. Simulations of passive mode-locking in a two-section QD laser are then performed as a function of the bias parameters. Gain and absorption dynamics leading to the generation of mode-locking pulses is described. The onset of a trailing-edge instability at low currents is observed and fully explained in the framework of the described model.
Digital Object Identifier:
10.1109/JQE.2010.2055550

30. Mantas Butkus, Jussi Rautiainen, Oleg G. Okhotnikov, Craig J. Hamilton, G. P. A. Malcolm, S. S. Mikhrin, Igor L. Krestnikov, D. A. Livshits, and Edik U. Rafailov, “Quantum Dot Based Semiconductor Disk Lasers for 1–1.3 μm”, IEEE Journal of Selected Topics in Quantum Electronics, Volume 17 Issue 6 (2011)
Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5735158
Abstract: Optically pumped quantum dot (QD)-based semiconductor disk lasers (SDLs) have been under intense research after their first demonstration and important enhancements of their parameters have been achieved since then. In this paper, we present recent developments in QD-based SDLs emitting in the 1--1.3-mum spectral region. Three different wavelength ranges of 1040, 1180, and 1260 nm were explored. Power scaling up to 6 W was achieved for 1040- and 1180-nm devices and up to 1.6 W for 1260-nm device. New spectral regions were covered by direct emission and frequency doubling was used to demonstrate spectral conversion into visible region with green, orange, and red light. Also, the broad gain bandwidth of QD materials was explored and wavelength tuneability up to 60 nm around 1040 nm, 69 nm around 1180 nm, and 25 nm around 1260 nm was demonstrated. The efficiency of excited and ground state emission in QDs was also compared. All these improvements allow new possibilities in applications of QD SDLs, reveal their potential, and suggest the aims for future research in the field.
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Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5739097
Abstract: Modelocked optically pumped vertical external cavity surface emitting lasers (VECSELs) have generated up to 6.4-W average power, which is higher than for any other semiconductor lasers. Electrical pumping of modelocked VECSELs is the next step toward a higher level of integration. With continuous wave (cw) electrically pumped (EP) VECSELs, an average output power of 900 mW has been demonstrated from the undisclosed proprietary novalux extended cavity surface emitting laser (NECSEL) design. In contrast, modelocked NECSELs have only been demonstrated at 40 mW. Recently, we presented a numerical study of EP-VECSELs suitable for modelocked operation; here, we demonstrate the first realization of this design. Power scaling is achieved with a lateral mode size increase. The competing electrical and optical requirements are, on the electrical side, low ohmic resistance, and on the optical side, low optical losses and low dispersion. Additionally, the device needs to operate in a fundamental mode for stable modelocking. We have fabricated and characterized 60 EP-VECSELs with varying dimensions and compared their lasing performance with our numerical simulations. The tradeoff between good beam quality and output power is discussed with an outlook to the modelocking of these EP-VECSELs. Initial EPVECSEL devices have generated >100 mW of cw output power.
Digital Object Identifier:
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Link: http://www.opticsinfobase.org/boe/abstract.cfm?URI=boe-2-4-739
Abstract: We present a portable ultrafast Semiconductor Disk Laser (SDL) (or vertical extended cavity surface emitting laser—VECSELs), to be used for nonlinear microscopy. The SDL is modelocked using a quantum-dot semiconductor saturable absorber mirror (SESAM), delivering an average output power of 287 mW, with 1.5 ps pulses at 500 MHz and a central wavelength of 965 nm. Specifically, despite the fact of having long pulses and high repetition rates, we demonstrate the potential of this laser for Two-Photon Excited Fluorescence (TPEF) imaging of in vivo Caenorhabditis elegans (C. elegans) expressing Green Fluorescent Protein (GFP) in a set of neuronal processes and cell bodies. Efficient TPEF imaging is achieved due to the fact that this wavelength matches the peak of the two-photon action cross section of this widely used fluorescent marker. The SDL extended versatility is shown by presenting Second Harmonic Generation images of pharynx, uterus, body wall muscles and its potential to be used to excite other different commercial dyes. Importantly this non-expensive, turn-key, compact laser system could be used as a platform to develop portable nonlinear bio-imaging devices.
Digital Object Identifier:

10.1364/BOE.2.000739

33. George J. Tserevelakis; George Filippidis; Costas Fotakis; Evgenia V. Megalou; Nektarios Tavemarakis, “Cell tracking in live *Caenorhabditis elegans* embryos via third harmonic generation imaging microscopy measurements”, Journal of Biomedical Optics, Volume 16 Issue 4 (2011)
Link: http://spie.org/x648.html?product_id=901329
Abstract: In this study, we demonstrate the potential of employing third harmonic generation (THG) imaging microscopy measurements for cell tracking studies in live *Caenorhabditis elegans* (*C. elegans*) embryos. A 1028-nm femtosecond laser was used for the excitation of unstained *C. elegans* samples. Different *C. elegans* embryonic stages (from two-cell to threefold) were imaged. Live biological specimens were irradiated for prolonged periods of time (up to 7 h), testifying to the nondestructive nature of this nonlinear imaging technique. Thus, THG image contrast modality is a powerful diagnostic tool for probing *in vivo* cell division during early embryogenesis.
Digital Object Identifier:
10.1117/1.3569615

34. Martin Hoffmann, Oliver D. Sieber, Valentin J. Wittwer, Igor L. Krestnikov, Daniil A. Livshits, Yohan Barbarin, Thomas Südmeyer, and Ursula Keller, “Femtosecond high-power quantum dot vertical external cavity surface emitting laser”, Optics Express, Volume 19 Issue 9 (2011)
Link: http://www.opticsinfobase.org/oe/abstract.cfm?URI=oe-19-9-8108
Abstract: We report on the first femtosecond vertical external cavity surface emitting laser (VECSEL) exceeding 1 W of average output power. The VECSEL is optically pumped, based on self-assembled InAs quantum dot (QD) gain layers, cooled efficiently using a thin disk geometry and passively modelocked with a fast quantum dot semiconductor saturable absorber mirror (SESAM). We developed a novel gain structure with a flat group delay dispersion (GDD) of ± 10 fs^2 over a range of 30 nm around the designed operation wavelength of 960 nm. This amount of GDD is several orders of magnitude lower compared to standard designs. Furthermore, we used an optimized positioning scheme of 63 QD gain layers to broaden and flatten the spectral gain. For stable and self-starting pulse formation, we have employed a QD-SESAM with a fast absorption recovery time of around 500 fs. We have achieved 1 W of average output power with 784-fs pulse duration at a repetition rate of 5.4 GHz. The QD-SESAM and the QD-VECSEL are operated with similar cavity mode areas, which is beneficial for higher repetition rates and the integration of both elements into a modelocked integrated external-cavity surface emitting laser (MIXSEL).
Digital Object Identifier:
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Abstract: A compact all-room-temperature frequency-doubling scheme generating cw orange light with a periodically poled potassium titanyl phosphate waveguide and a quantum-dot external cavity diode laser is demonstrated. A frequency-doubled power of up to 4.3 mW at the wavelength of 612.9 nm with a conversion efficiency exceeding 10% is reported. Second harmonic wavelength tuning between 612.9 nm and 616.3 nm by changing the temperature of the crystal is also demonstrated.
Digital Object Identifier:
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36. Maria Ana Cataluna, Ying Ding, Daniil I. Nikitichev, Ksenia A. Fedorova, and Edik U. Rafailov, "High-Power Versatile Picosecond Pulse Generation from Mode-Locked Quantum-Dot Laser Diodes", Invited Paper, IEEE Journal of Selected Topics in Quantum Electronics Volume 17 Issue 5 (2011)
Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5771033
Abstract: This paper presents the current status of our research in mode-locked quantum-dot edge-emitting laser diodes, particularly highlighting the recent progress in spectral and temporal versatility of bothmonolithic and external-cavity laser configurations. Spectral versatility is demonstrated through broadband tenability and novel mode-locking regimes that involve distinct spectral bands, such as dual-wavelength mode-locking, and robust highpower wavelength bistability. Broad tunability of the pulse repetition rate is also demonstrated for an external-cavity mode-locked quantum-dot laser, revealing a nearly constant pulse peak power at different pulse repetition rates. High-energy and low-noise pulse generations are demonstrated for low-pulse repetition rates. These recent advances confirm the potential of quantum-dot lasers as versatile, compact, and low-cost sources of ultrashort pulses.
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Abstract: We present a detailed quantitative comparison between a finite-difference traveling wave (FDTW) model and a delayed differential equation (DDE) approach for the simulation of passive mode-locking in quantum dot lasers with both ring and Fabry–Perot (FP) cavities. Modifications with respect to the standard DDE models available in the literature are proposed. The new DDE approach improves the quantitative agreement with the FDTW model when applied to the simulation of passive mode-locking in FP lasers, preserving a very high computational efficiency. The modifications proposed in the DDE model also apply to the simulation of quantum-well and bulk devices.
Digital Object Identifier:

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Abstract: We report picosecond pulse generation with high peak power in the range of 3.6 W from monolithic passively mode-locked tapered quantum-dot laser diodes, exhibiting low divergence and good beam quality. These results were achieved using a gain-guided tapered laser geometry. The generation of picosecond pulses with high average power up to 209 mW directly from such tapered lasers is also demonstrated, corresponding to 14.2 pJ pulse energy (14.65 GHz repetition rate). A comparison between the mode-locking performance of these tapered lasers incorporating either five or ten layers of InAs/GaAs self-organized quantum dots in their active layer is also presented.
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Digital Object Identifier: 10.1143/APEX.4.062703

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Digital Object Identifier: 10.1049/iet-opt.2010.0071

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Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5893899
Abstract: We present timing jitter measurements of an InGaAs quantum well vertical external cavity surface emitting laser (VECSEL) passively mode locked with a quantum dot semiconductor saturable absorber mirror (SESAM) at 2-GHz repetition rate. It generates 53-mW average output power in 4.6-ps pulses at 953 nm. The laser housing was optimized for high mechanical stability to reduce acoustic noise. We use a fiber-coupled multimode 808-nm pump diode, which is mounted inside the laser housing. No active cavity length stabilization is employed. The phase noise of the free-running laser integrated over a bandwidth from 100 Hz to 1 MHz corresponds to an RMS timing jitter of _212 fs, which is lower than previously obtained for mode-locked VECSELs. This clearly confirms the superior noise performance expected from a high-Q-cavity semiconductor laser. In contrast to edge-emitting semiconductor diode lasers, the cavity mode is perpendicular to the quantum well gain layers, which minimizes complex dispersion and nonlinear dynamics.
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Abstract: A simple passive electrical circuit that is able to suppress *Q*-switching instabilities in mode-locked semiconductor quantum dot lasers has been demonstrated. By connecting frequency-selective electrical components to the absorber section of a monolithic twosection tapered laser, a team at the Technical University of Darmstadt in Germany were able to eliminate the *Q*-switching instabilities and extend the stable mode-locking range.
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Abstract: The elimination of Q-switching instabilities in passively modelocked monolithic semiconductor lasers by connecting passive electrical components to the absorber section is demonstrated. Suppression of Q-switching and Q-switched modelocking for a passively modelocked monolithic two-section quantum-dot tapered laser are achieved. In addition, extension of the modelocking operation range towards lower gain currents is accomplished, thus improving generation of ultrashort pulses. The suppression is attributed to the effective damping of low frequency photocurrent fluctuations in the absorber section.

Digital Object Identifier: 10.1049/el.2011.1802

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Abstract: Femtosecond laser assisted nanosurgery of microscopic biological specimens is a relatively new technique which allows the selective disruption of sub-cellular structures without causing any undesirable damage to the surrounding regions. The targeted structures have to be stained in order to be clearly visualized for the nanosurgery procedure. However, the validation of the final nanosurgery result is difficult, since the targeted structure could be simply photobleached rather than selectively destroyed. This fact comprises a main drawback of this technique. In our study we employed a multimodal system which integrates non-linear imaging modalities with nanosurgery capabilities, for the selective disruption of sub-cellular structures in HeLa cancer cells. Third Harmonic Generation (THG) imaging modality was used as a tool for the identification of structures that were subjected to nanosurgery experiments. No staining of the biological samples was required, since THG is an intrinsic property of matter. Furthermore, cells' viability after nanosurgery processing was verified via Two Photon Excitation Fluorescence (TPEF) measurements.
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Abstract: We report on the simulation of passive mode locking (ML) in quantum dot (QD) two-section lasers via a multi-section delayed differential equation model. The influence of the laser structural parameters on the achieved ML regimes is investigated. We show that, consistently with experimental findings, increasing the saturable absorber (SA) to gain section length ratio from 17% to 25%, a significant pulse shortening can be achieved. A physical explanation for this behavior is obtained via a detailed study of the gain and absorption saturation dynamics leading to the self consistent ML solution, in particular the competition between spectral hole burning non-linearity and total carrier density depletion responsible for the gain saturation in the gain section, balancing the absorption bleaching in the SA, is shown to play a central role in determining the observed ML regimes. In addition, the impact of introducing a tapered gain section in QD ML lasers are investigated, the possibility to achieve high power subpicosecond pulses from such devices is theoretically demonstrated and attributed to the significantly increased gain saturation energy in the tapered gain section.
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Abstract: Embryo patterning is subject to intense investigation. So far only large, microscopically obvious structures like polar body, cleavage furrow, pro-nucleus shape can be evaluated in the intact embryo. Using non-linear microscopic techniques, the present work describes new methodologies to evaluate pre-implantation mouse embryo patterning. Third Harmonic Generation (THG) imaging, by detecting mitochondrial/lipid body structures, could provide valuable and complementary information as to the energetic status of pre-implantation embryos, time evolution of different developmental stages, embryo polarization prior to mitotic division and blastomere equivalence. Quantification of THG imaging detected highest signalling in the 2-cell stage embryos, while evaluating a 12–18% difference between blastomeres at the 8-cell stage embryos. Such a methodology provides novel, non-intrusive imaging assays to follow up intracellular structural patterning associated with the energetic status of a developing embryo, which could be successfully used for embryo selection during the *in vitro* fertilization process.
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Abstract: We report the first demonstration of a Ti:sapphire laser mode-locked with a quantum-dot mode-locker (QDM) at repetition rates up to 1.77 GHz with 8-ps pulse duration and 400-mW average output power. So far, with quantum-well-based mode-lockers, a repetition rate of only up to 300 MHz has been achievable in our experiments. We show that QDM can support mode-locking in a wide range of repetition rates from 100 MHz to 1.8 GHz.
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Abstract: We propose a computationally efficient approach for the simulation and design of index-guided quantumdot (QD) passively mode-locked lasers with tapered gain section; the method is based on the combination of simulations based on a finite difference beampropagation-method and dynamic simulations of mode-locking via a multi-section delayed differential equation model. The impact of varying the taper full angle on the pulse duration and peak power is investigated; simulations show that a correct choice of this parameter enables the generation of sub-picosecond optical pulses with peak power exceeding 5 W.

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Abstract: We present a femtosecond vertical external cavity surface emitting laser (VECSEL) that is continuously tunable in repetition rate from 6.5 GHz up to 11.3 GHz. The use of a low-saturation fluence semiconductor saturable absorber mirror (SESAM) enables stable cw modelocking with a simple cavity design, for which the laser mode area on SESAM and VECSEL are similar and do not significantly change for a variation in cavity length. Without any realignment of the cavity for the full tuning range, the pulse duration remained nearly constant around 625 fs with less than 3.5% standard deviation. The center wavelength only changed ±0.2 nm around 963.8 nm, while the output power was 169 mW with less than 6% standard deviation. Such a tunable repetition rate is interesting for various metrology applications such as optical sampling by laser cavity tuning (OSCAT).
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Abstract: A new diagnostic approach for assessing the in-depth laser induced modifications upon ultraviolet polymer irradiation is presented. The methodology relies on the observation of morphological alterations in the bulk material (Paraloid B72) by using third harmonic generation. This non destructive methodology allows the detailed and accurate imaging of the structurally laser modified zone extent in the vicinity of the irradiated area. Additionally, for the first time, the visualization and quantitative determination of the contour of the *laser-induced swelling/bulk material interface* is reported. The observed polymer surface swelling following single-pulse KrF laser irradiation at sub-ablation fluences is interpreted in the context of a model for laser-induced bubble formation due to droplet explosion mechanism.
Digital Object Identifier: 10.1364/OE.20.003990

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Abstract: We present the first full gain characterization of two vertical external cavity surface emitting laser (VECSEL) gain chips with similar designs operating in the 960-nm wavelength regime. We optically pump the structures with continuous-wave (cw) 808-nm radiation and measure the nonlinear reflectivity for 130-fs and 1.4-ps probe pulses as function of probe pulse fluence, pump power, and heat sink temperature. With this technique we are able to measure the saturation behavior for VECSEL gain chips for the first time. The characterization with 1.4-ps pulses resulted in saturation fluences of 40-80 μJ/cm2, while probing with 130-fs pulses yields reduced saturation fluences of 30-50 μJ/cm2 for both structures. For both pulse durations this is lower than previously assumed. A small-signal gain of up to 5% is obtained with this technique. Furthermore, in a second measurement setup, we characterize the spectral dependence of the gain using a tunable cw probe beam. We measure a gain bandwidth of over 26 nm for both structures, full width at half maximum.
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Abstract: We report on the development of a new generation of high_power ultrashort pulse quantum_dot lasers with tapered gain section. Two device designs are proposed and fabricated, with different total lengths and absorber_to_gain_section length_ratios. These designs have been informed by numerical simulations of the dynamic mode_locking regimes and their dependence on the structural parameters. One device design demonstrated a record_high peak power of 17.7 W with 1.26 ps pulse width and a second design enabled the generation of a Fourier_limited 672 fs pulse width with a peak power of 3.8 W. A maximum output average power of 288 mW with 28.7 pJ pulse energy was also attained. In addition, the integrated timing jitter of 2.6 ps and far_field patterns are demonstrated.
Digital Object Identifier: 10.1134/S1054660X12040147

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Abstract: In this paper, we present the generation of high peak-power picosecond optical pulses in the 1.26 μm spectral band from a repetitionrate-tunable quantum-dot external-cavity passively mode-locked laser (QDECMLL), amplified by a tapered quantum-dot semiconductor optical amplifier (QD-SOA). The laser emission wavelength was controlled through a chirped volume Bragg grating which was used as an external cavity output coupler. An average power of 208.2 mW, pulse energy of 321 pJ, and peak power of 30.3 W were achieved. Preliminary nonlinear imaging investigations indicate that this system is promising as a high peakpower pulsed light source for nonlinear bio-imaging applications across the 1.0 μm - 1.3 μm spectral range.
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53. Z. Y. Zhang, A. E. H. Oehler, B. Resan, S. Kurmulis, K. J. Zhou, Q. Wang, M. Mangold, T. Südmeyer, U. Keller, K. J. Weingarten & R. A. Hogg, "1.55 μm InAs/GaAs Quantum Dots and High Repetition Rate Quantum Dot SESAM Mode-locked Laser", *Scientific Reports* 2, Article number 477
Link: http://www.nature.com/srep/2012/120628/srep00477/full/srep00477.html
Abstract: High pulse repetition rate (≥10 GHz) diode-pumped solid-state lasers, modelocked using semiconductor saturable absorber mirrors (SESAMs) are emerging as an enabling technology for high data rate coherent communication systems owing to their low noise and pulse-to-pulse optical phase-coherence. Quantum dot (QD) based SESAMs offer potential advantages to such laser systems in terms of reduced saturation fluence, broader bandwidth, and wavelength flexibility. Here, we describe the development of an epitaxial process for the realization of high optical quality 1.55 μm In(Ga)As QDs on GaAs substrates, their incorporation into a SESAM, and the realization of the first 10 GHz repetition rate QD-SESAM modelocked laser at 1.55 μm, exhibiting ~2 ps pulse width from an Er-doped glass oscillator (ERGO). With a high

areal dot density and strong light emission, this QD structure is a very promising candidate for many other applications, such as laser diodes, optical amplifiers, non-linear and photonic crystal based devices.
Digital Object Identifier: 10.1038/srep00477

2008

1. E. U. Rafailov, M. A. Cataluna, “Compact Ultrashort Pulse Lasers Based on Quantum-Dot Structures”, IEEE LEOS 2008 (Invited talk)
Link: n/a
Abstract:
In this review we describe how quantum-dot structures have opened up new avenues in ultrafast science and technology, enabling efficient and compact devices for the generation and amplification of ultrashort optical pulses.

2009

2. E. U. Rafailov, M. A. Cataluna, K. Wilcox, S. A. Zolotovskaya, “Compact ultrafast lasers based on quantum-dot structures”, Photonics West 2009 (Invited talk)
Link: http://spie.org/x648.html?product_id=813578
Abstract:
Novel materials, notably quantum-dot (QD) semiconductor structures offer the unique possibility of combining exploitable spectral broadening of both gain and absorption with ultrafast carrier dynamic properties. Thanks to these characteristics QD-based devices have enhanced the properties of ultrashort pulse lasers and opened up new possibilities in ultrafast science and technology. In this paper we will review recent results, which demonstrate that quantum-dot structures can be designed to provide compact and efficient ultrashort pulse laser sources with extremely high and low repetition rates.
Digital Object Identifier:
10.1117/12.813578

3. Keith G Wilcox, Mantas Butkus, Anne Tropper, Ian Farrer, David A Ritchie, Edik U Rafailov, “870-fs Passively Mode-Locked Quantum Dot SESAM Semiconductor Disk Laser”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-MB19
Abstract:
We report a sub-picosecond pulse train generated by a passively mode-locked QDSESAM Semiconductor Disk Laser. We obtained 870-fs pulses at a repetition rate of 895MHz with average output power of 45mW at 1027.5nm.

4. Benjamin Rudin, Andreas Rutz, Deran J. H. C. Maas, Aude Reine Bellancourt, Emilio Gini, Thomas Südmeyer, Ursula Keller, “Efficient high-power VECSEL generates 20 W continuous-wave radiation in a fundamental transverse mode”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-ME2
Abstract:

We demonstrate a 960-nm VECSEL generating 20 W continuous-wave output power in TEM_{00} transverse mode. The highly efficient laser has a slope efficiency of 49% and an overall optical-to-optical efficiency of 43%.

5. Martin Hoffmann, Yohan Barbarin, Deran J. H. C. Maas, Matthias Golling, Thomas Südmeyer, Ursula Keller, Igor L. Krestnikov, Sergey S. Mikhrin, Alexey R. Kovsh, “First Modelocked Quantum Dot Vertical External Cavity Surface Emitting Laser”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-ME5
Abstract:
We report the first successful modelocking of a VECSEL with a quantum dot gain region. We obtain 27.4 mW average output power at 1059 nm wavelength in 18 ps pulses with 2.57 GHz repetition rate.

6. Deran J. H. C. Maas, Martin Hoffmann, Aude Reine Bellancourt, Benjamin Rudin, Yohan Barbarin, Matthias Golling, Thomas Südmeyer, Ursula Keller, “Growth Parameter Optimization for Fast Quantum Dot Semiconductor Saturable Absorber Mirrors (QD-SESAMs)”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-TuB11
Abstract:
We present the first systematic study on QD-SESAM growth parameters and post-growth annealing. We achieve low saturation fluence and fast recovery, which is important for increasing repetition rate and reducing pulse duration in ultrafast lasers.

7. K. Seger, B. Jacobsson, V. Pasiskevicius, F. Laurell, ” Tunable Yb:KYW laser using a transversely chirped volume Bragg grating”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-TuB15
Abstract:
An Yb:KYW laser was locked using a transversely chirped volume-Bragg-grating. Translating the grating, the laser tuned from 997 nm to 1015 nm, with spectral bandwidth of 13 GHz and power up to 3.0W.

8. P. Jelger, V. Pasiskevicius, F. Laurell, ”Narrow linewidth dual volume-Bragg-grating locked Ytterbium-doped fiber laser”, Advanced Solid-State Photonics (ASSP) 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=ASSP-2009-TuB26
Abstract:

Two identical highly reflective volume Bragg gratings are used in tandem to lock an ytterbium doped fiber laser. A narrow linewidth (<2GHz) and high efficiency (>70%) is achieved with output powers above 7W.

9. Martin Hoffmann, Yohan Barbarin, Deran J. H. C. Maas, Aude-Reine Bellancourt, Mohammad Shafiei , Matthias Golling, Thomas Südmeyer, Ursula Keller, Igor L. Krestnikov, Sergey S. Mikhrin, Alexey R. Kovsh, "All Quantum Dot Modelocked Vertical External Cavity Surface Emitting Laser", CLEO | IQEC09
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO-2009-JThE13
Abstract:
We report the first entirely quantum-dot-based SESAM-modelocked VECSEL, using quantum-dot layers for gain and absorber. We obtain 22 mW average output power at 1053 nm wavelength in 10-ps pulses with 2.54 GHz repetition rate.

10. M. Rossetti, P. Bardella, M. Gioannini, and I.Montrosset, "Time Domain Travelling Wave Model for Simulation of Passive Mode Locking in Quantum Dot Lasers", CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CF_P21
Abstract:
A time domain model for quantum dot lasers and saturable absorbers is described. Simulations of differential transmission spectroscopy in saturable absorbers are compared with experiments and passive mode locking in quantum dot lasers is investigated.

11. M.A. Cataluna, D.I. Nikitchev, I. Krestnikov, D.A. Livshits, A.R. Kovsh, and E.U. Rafailov, "Dual-wavelength mode-locked GaAs based quantum-dot laser", CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CB4_6
Abstract:
We report a dual-wavelength passive mode locking regime where picosecond pulses are generated simultaneously from both ground (λ=1180nm) and excited states (λ=1263nm), in a GaAs-based two-section quantum-dot laser.

12. K. Fedorova, M.A. Cataluna, A. Abdolvand, P. Battle, I. Krestnikov, D. Livshits, M. Khomylev, and E. Rafailov, "Generation of orange light from a PPKTP waveguide end-pumped by a quantum-dot tuneable laser" , CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CD_P26
Abstract:

We present a compact all-room-temperature frequency doubling scheme generating 1.43 mW orange light at 613nm for 70mW of launched pump power at 1226nm, using a PPKTP waveguide and a quantum-dot external cavity diode laser.

13. M. Butkus, K. Wilcox, J. Rautiainen, O. Okhotnikov, S. Mikhrin, I. Krestnikov, A. Kovsh, M. Hoffmann, T. Südmeyer, U. Keller, and E. Rafailov, "High-Power Quantum Dot Based Semiconductor Disk Laser , CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CB5_1
Abstract:
We report the first room temperature multi-Watt (> 4W) continuous wave semiconductor disk laser based on quantum dots grown in the Stranski-Krastanow regime. Samples with and without diamond heat spreader are compared.

14. M. Hoffmann, Y. Barbarin, D.J.H.C. Maas, A.-R. Bellancourt, M. Shafiei, M. Golling, T. Südmeyer, U. Keller, I.L. Krestnikov, S.S. Mikhrin, and A.R. Kovsh, "First modelocked Vertical External Cavity Surface Emitting Laser using quantum dot layers for gain and SESAM" , CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CB5_2
Abstract:
QD-layers offer a larger design freedom for ultrafast VECSELs than standard quantum wells. We demonstrate the first modelocked VECSEL with QD-layers both for gain and saturable absorber, initially achieving 10-ps pulses at 1053-nm wavelength.

15. M. Hoffmann, D.J.H.C.Maas, O. Sieber, V.J. Wittwer, A.-R. Bellancourt, B. Rudin, Y. Barbarin, M.Golling, T. Südmeyer, and U.Keller, "First experimental verification of soliton-like pulse-shaping mechanisms in passively mode-locked VECSELs" , CLEO®/Europe-EQEC 2009
Link: http://www.opticsinfobase.org/abstract.cfm?URI=CLEO_E-2009-CB14_2
Abstract:
We present the first detailed experimental study on the influence of dispersion on pulse duration of ultrafast VECSELs. Optimizing dispersion strongly reduces duration, which is in excellent agreement with the quasisoliton pulse formation theory.

16. E. Jelmakas, R. Tomasiunas, K. Wilcox, E. Rafailov, I. Krestnikov, "InGaAs Quantum Dot 1050 nm Saturable Absorber Mirror: Investigation under High Excitation Condition", 11th International Conference on Transparent Optical Networks

Link: n/a
Abstract: In this paper, semiconductor saturable absorber mirror designed for the near-IR spectra and based on InGaAs quantum dots was investigated. Absorption saturation, absorption femtosecond recovery kinetics measured at various close to resonance quantum energies

revealed the wavelength ~ 1050 nm as best performing absorption bleaching (highest value of 2 % for reflectivity change) for this sample. Nonlinear absorption, carrier thermalization appeared to govern carrier generation, their dynamics in the quantum dots.

17. Mattia Rossetti, Paolo Bardella, Ivo Montrosset. “Modelling passive mode-locking in quantum-dot lasers using FDTW with multi-population rate equations”. i-NOW 2009, Stockholm, Sweden and Berlin, Germany
Link: n/a
Abstract:
Passive mode-locking (ML) in quantum dot (QD) lasers is modelled via a time-domain travelling-wave model including an accurate description of QD gain and absorption dynamics and related refractive index changes using multi-population rate equations.

18. H. Porte, P. Uhd Jepsen, N. Daghestani, K. G. Wilcox, E. U. Rafailov, and D. Turchinovich, “Capture and release of carriers in InGaAs/GaAs quantum dots”, 16th International Conference on Electron Dynamics In Semiconductors, Optoelectronics and Nanostructures (EDISON16), Montpelier
Link: http://www.iop.org/EJ/article/1742-6596/193/1/012085/jpconf9_193_012085.pdf?request-id=75065739-ccc7-4608-add8-93b125b63642
Abstract:
In this work we have studied ultrafast capture and release of photoexcited carriers in an InGaAs/GaAs quantum dot semiconductor saturable absorber mirror (QD SESAM), optimized for operation at wavelength of 1030 nm.

19. M. Rossetti, P. Bardella, I. Montrosset , "A time-domain travelling-wave model including multi-population rate-equations for passively mode-locked quantum-dot lasers", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:
We developed a time-domain travelling wave model including multi-population rate equations to describe the in-homogeneously broadened gain and absorption dynamics and the related refractive index changes in self assembled quantum dots (QDs). Simulations of passive mode-locking (ML) in QD lasers are shown.

20. S. A. Zolotovskaya, K. G. Wilcox, A. Abdolvand, D. A. Livshits, E. U. Rafailov, "p-n junction quantum dot SESAM passively mode-locked Cr:Forsterite laser", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:

Stable passive mode-locking of a Cr:forsterite laser using a voltage controlled p-n junction quantum dot SESAM is presented. Output shortening from 17.4 to 6.4 ps near-transform limited pulses was obtained by applying reverse bias.

21. K. A. Fedorova, M. A. Cataluna, I. Krestnikov, D. Livshits, E. U. Rafailov, "Tuning range enhancement in external-cavity InAs/GaAs quantum-dot lasers: temperature, bias and cavity loss dependence", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:
We exploit a number of strategies for enhancing the tuning range of external-cavity quantum-dot lasers. Reducing the temperature and increasing the pump current can increase the tuning range to the shorter wavelength side, whereas reducing cavity losses additionally extends the tenability range to the red side of the spectrum.

22. D. I. Nikitichev, M. A. Cataluna, I. Krestnikov, D. Livshits, E. U. Rafailov, "Investigation of the pulse dynamics in a mode-locked quantum-dot laser, involving the ground/excited state transitions", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:
We investigate the generation of ultrashort pulses in an InAs/GaAs multi-section quantum- dot laser involving the excited or ground state transitions. We demonstrate that the dependence of pulse duration with the bias conditions is different for pulses generated via ground or excited states.

23. M. Butkus, J. Rautiainen, O. G. Okhotnikov, S.S. Mikhrin, I.L. Krestnikov, E. U. Rafailov, "Quantum dot semiconductor disk laser operating at 1270 nm", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:
We demonstrate up to 55 mW continuous wave output power from an opticallypumped InGaAs/GaAs quantum dot semiconductor disk laser with centre wavelength at 1270. High temperature resilience in terms of output power has been demonstrated.

24. J. Rautiainen, M. Butkus, S. S. Mikhrin, I. L. Krestnikov, E. U. Rafailov, O.G. Okhotnikov , "1.2 μm Quantum Dot Semiconductor Disk Laser with 0.5 W of Output Power", 1st EOS Topical Meeting on Lasers, Capri, Italy
Link: n/a
Abstract:

We demonstrate up to 500 mW CW output power from an optically-pumped InGaAs/GaAs quantum dot substrate-free semiconductor disk laser with centre wavelength at 1185 nm. The tunability of the device has been investigated.

2010

25. Edik U. Rafailov, Maria-Ana Cataluna, “Progress on compact ultrafast quantum dot based lasers”, (Invited Paper), SPIE Photonics West 2010
Link:
http://scitation.aip.org/vsearch/servlet/VerityServlet?KEY=SPIN&smode=strresults&sort=chron&maxdisp=25&threshold=0&possible1=%22Progress+on+compact+ultrafast+quantum+dot+based+lasers%22&possible1zone=article&OUTLOG=NO&viewabs=PSISDG&key=DISPLAY&docID=1&page=1&chapter=0
Abstract:
We review the recent progress on the development of novel quantum-dot structures and laser devices. The investigation of novel regimes of ultrashort pulse generation in quantum-dot edge-emitting lasers will be presented. We will illustrate how new functionalities have been opened up, such as dual-wavelength mode-locking and enhanced tunability, through the exploitation of the excited-state transitions in the quantum dots as an additional degree of freedom in these ultrafast lasers. Progress on novel design rules for quantum-dot based vertical external cavity lasers and SESAMs are also considered.
Digital Object Identifier:
10.1117/12.843690

26. Oliver D.Sieber, Martin Hoffmann, Deran J. H. C. Maas, Valentin J. Wittwer, Matthias Golling, Thomas Südmeyer, Ursula Keller, “Experimental Confirmation of Quasi-Soliton Pulse Formation in Ultrafast VECSELs”, Advanced Solid-State Photonics (ASSP) 2010
Link: n/a
Abstract:
A detailed experimental study on pulse formation in ultrafast VECSELs confirms that shortest pulses require slightly positive dispersion to balance saturation effects. These results are in good agreement with simulations, confirming the quasi-soliton pulse-formation theory.

27. M Rossetti, P Bardella, I Montrosset, S Breuer, W Elsasser, "Simulation and design of quantum-dot lasers operating in dual-wavelength passive mode-locking regime", 15th European Conference on Integrated Optics, ECIO 2010, Cambridge, UK
Link: n/a
Abstract:

Simultaneous pulse generation from ground state and excited state transitions in a two section quantum dot laser is studied via a finite difference travelling-wave model; design rules to obtain stable dual-wavelength mode-locking regime over a wide range of bias current and voltage are proposed.

28. W Pallmann, Y Barbarin, M Hoffmann, M Golling, T Südmeyer, U Keller, P Kreuter, B Witzigmann, “Design and continuous-wave characterization of electrically pumped VECSELs suitable for passive modelocking”, 15th European Conference on Integrated Optics, ECIO 2010, Cambridge, UK
Link: n/a
Abstract:
An ultrafast electrically pumped VECSEL design suitable for passive modelocking requires an acceptable trade-off in cw output power. Validating our design guidelines, 120 mW of cw output power are generated. Homogenous current injection is achieved even for large devices, as predicted by our simulations.

29. Rodrigo Aviles-Espinosa, G. J. Tserevelakis, Susana I. C. O. Santos, G. Filippidis, A. J. Krmpot, M. Vlachos, N. Tavernarakis, A. Brodschelm, W. Kaenders, David Artigas, Pablo Loza-Alvarez, “Cell Division Stage in C. elegans Imaged Using Third Harmonic Generation Microscopy”, Biomedical Optics (BIOMED), Topical Meeting and Tabletop Exhibit, Miami, FL, USA
Link: n/a
Abstract:
C. elegans embryogenesis, at the cell division stage, was imaged using third harmonic generation microscopy employing ultrashort pulsed lasers at 1028nm and 1550nm. This technique could be used for cell tracking studies without fluorescent markers.

30. Maria ana Cataluna, Edik Rafalov, “Versatile mode-locked quantum-dot laser diodes”, Invited paper, SPIE Photonics Europe 2010, Session 7.
Link: n/a
Abstract:
Semiconductor quantum-dots have been recently showing great promise for the generation of ultrashort pulses, forming the basis of very compact and efficient ultrafast laser sources. In this talk we discuss how the unique properties of quantum-dot materials can be exploited in novel and versatile mode-locking regimes in InAs/GaAs quantum-dot edge-emitting lasers, both in monolithic and external cavity configurations. We present the current status of our research on ultrashort pulse generation involving ground (1260nm) and excited-state (1180nm) transitions, as well as the recent progress in external-cavity broadband tunable and mode-locked quantum-dot lasers.

31. Stefan Breuer, Wolfgang E. Elsaesser, Mattia Rossetti, Ivo Montrosset, Mark Hopkinson, Michel Krakowski, “Reverse excited state/ ground state dynamics in mode-locked two-section quantum dot semiconductor lasers”, SPIE Photonics Europe 2010, Session 7.
Link: n/a
Abstract:
Quantum Dot (QD) semiconductor lasers exhibit, besides the large variety of their application point-of-view (Bimberg, D., J. Phys., 15, R1063 (2003), Rafailov, E.U. et al., Nature Phot. 1, 395 (2007)) a particular interesting dynamical behaviour due to the existence of ground state (GS) and excited state (ES) in the dot energy scheme and the quite complicated interaction between them and the wetting layer (Viktorov, E.A. et al., APL 90, 121113 (2007), Gioannini, M. et al. JQE 43, 941 (2007)). One very recently found highlight is the observed coexistence of GS and ES in mode-locked QD lasers where with increasing current a transition from GS to ES is found with even a coexistence regime at intermediate current with simultaneous lasing of both transitions (Cataluna, M.A. et al., CLEO Europe, CB4.6 (2009)).
Here, we have designed a particular QD structure where we observe the reverse behaviour, i.e. lasing starts first on the ES state and then a transition to GS lasing takes place with a huge coexistence regime of both, GS and ES. The lasers consists out of a two-section 3.3 µm ridge waveguide structure, with a 300 µm long absorbing section and a 3000 µm long gain section, respectively with facets as cleaved. Already with a zero Volt absorber voltage and a gain segment current of 108 mA mode locking occurs, however, on the ES. With increasing current the intensity of the GS increases, until finally coexisting lasing on both states, GS and ES takes place. At even higher gain currents, the GS dominates. The simultaneity of the two-state mode locked operation is confirmed via the occurrence of a clear four-wave mixing signal between GS and ES in the electrical beat spectra. Spectrally filtered state-resolved power-current characteristics clearly demonstrate the complementary behaviour of ES and GS which is also reflected in the pulse width dependence of the mode-locked pulses. This particularly surprising reverse GS/ES state dynamics which we attribute to designed losses of the lasers structure are finally confirmed by time-domain travelling-wave equation modelling.

32. Mattia Rossetti, Paolo Bardella, Ivo Montrosset, “Modelling differential transmission spectroscopy experiments in quantum dot optical amplifiers and saturable absorbers”, SPIE Photonics Europe 2010.
Link: n/a
Abstract:
Quantum Dot (QD) Semiconductor Optical Amplifiers (SOA) have shown an impressive potential for pulse amplification thanks to their ultrafast gain recovery. Furthermore, QD saturable absorbers (SA) have shown recovery times down to 1ps suitable for applications in integrated mode-locked lasers and SESAMs. In order to investigate gain and absorption dynamics in such devices, we developed a model based on a time domain-travelling wave algorithm where the field propagation equation is coupled with a set of multi-population rate equations modelling carrier dynamics in the QD layers under both forward and reverse bias. QD gain and refractive index spectra are properly introduced in the field propagation equation via numerical filters describing the inhomogeneous gain broadening and the homogeneous linewidth of each interband transition. The model is used to simulate Differential Transmission Spectroscopy experiments in QD SOAs and SAs. A 250fs pump pulse with 1.28pJ energy, resonant to the ground state (GS) transition is considered.

33. Robert Herda, Andreas Brodschelm, Thomas Hellerer, Frank Lison, " Generation of Frequency-Doubled 55 fs Pulses from an Erbium Fiber Laser System", CLEO/QELS: 2010 San Jose, California
Link: n/a
Abstract:
The pulses of an Erbium-doped fiber-laser system are frequency doubled to 780 nm and compressed in a Gires-Tournois-interferometer mirror pair to a duration of 55 fs having a peak power of 35 kW.

34. Martin Hoffmann, Yohan Barbarin, Wolfgang P. Pallmann, Deran J. H. C. Maas, Philipp Kreuter, Bernd Witzigmann, Matthias Golling, Thomas Südmeyer, Ursula Keller, "Simulation, Design, and Characterization of Electrically-Pumped VECSELs for Future Passive Modelocking", CLEO/QELS: 2010 San Jose, California
Link: n/a
Abstract:
An ultrafast electrically-pumped VECSEL design requires an acceptable trade-off in cw output power. Validating our design guidelines and simulations 120 mW cw output power are generated. Homogenous current injection is even achieved for large devices.

35. Andrius Zukauskas, Valdas Pasiskevicius, Fredrik Laurell, Carlota Canalias, "Grey-Track Resistant Periodically Poled Rb-Doped KTiOPO4 For Blue-Light Generation", CLEO/QELS: 2010 San Jose, California
Link: n/a
Abstract:
We present periodic poling of Rb-doped KTiOPO4. The crystal is used to obtain blue radiation at 398 nm with an efficiency of 30% and a peak intensity of 2 MW/cm2 without grey-tracking

36. Bojan Resan and Kurt Weingarten, "Compact ultrafast lasers for biomedical applications", From Solid State To BioPhysics V International conference, Dubrovnik, Croatia
Link: n/a
Abstract:
The modelocking technique for generating femtosecond pulses will be introduced and the state-of-the-art in ultrafast lasers will be briefly reviewed. We will discuss an important laser Figure of Merit for applications in Two-Photon Imaging and Nanosurgery. Based on this Figure of

Merit and properties of ultrafast pulse propagation through a material, we are developing a novel versatile femtosecond pulse source based on a high-power, low-noise diode pumped solid-state laser seeding a photonics crystal fiber. Furthermore, we will review trends towards miniature solid-state and semiconductor ultrafast lasers based on quantum dot technologies with applications in telecommunications and bioimaging.

37. E. Jelmakas, R. Tomašiūnas, E. Rafailov and I. Krestnikov, "Photoinduced absorption saturation dynamics of InGaAs quantum dot structure dedicated for wavelength 1070 nm", 12th International Conference on Transparent Optical Networks, ICTON 10, Munich, Germany
Link: n/a
Abstract:
In this paper, results of investigation of InGaAs quantum dot structure designed as a semiconductor saturable absorber for near-IR are presented. Photoinduced absorption bleaching spectroscopy performed confirm the dedicated wavelength 1070 nm for absorption bleaching of the ground state of quantum dots. Transitions including states from the wetting layer and the ground states have been interpreted to define absorption recovery dynamics on femto- and picosecond time scale. Fast recovery time of absorption was measured for the upper excited energy levels, while the ground state dynamics show relative longer times. Non-degenerate pump-probe technique was applied to investigate the interstate transition dynamics.

38. S. Breuer, M. Rossetti, W. Elsässer, L. Drzewietzki, P. Bardella, I. Montrosset, M. Krakowski, M. Hopkinson, ” Two-state passive mode-locking of quantum dot semiconductor lasers: Classical state scenario and novel reverse state dynamics”, 12th International Conference on Transparent Optical Networks, ICTON 10, Munich, Germany
Link: n/a
Abstract:
We present both experimental and theoretical investigations of the so-called reverse emission state dynamics in a two-section InAs/InGaAs Quantum Dot (QD) laser. In contrast to the classical state scenario, we demonstrate by properly designing the laser cavity and the QD active region, a reversal of the emission state transition: At a certain gain current Excited-state (ES) lasing and mode-locking (ML) starts first and then, with increasing gain current, a transition to simultaneous ES and ground-state (GS) ML takes place. This enables a novel approach to wavelength-switching of the mode-locked pulses over a range of 63 nm: the realization of a two-section QD laser with a resistor Self-Electro-optic Effect Device (SEED) configuration. These results are reviewed together with the state-of-the-art realization of InAs/InGaAs two-section QD lasers operating in two-state ML regime.

39. D. I. Nikitichev, M. A. Cataluna, M.Ruiz, M. Calligaro, N. Michel, M. Krakowski, D. Livshits and E. U. Rafailov, “High-power passively mode-locked tapered quantum-dot laser”, 14th International Conference "Laser Optics 2010", St.Petersburg, Russia
Link: n/a

Abstract:
Pulse generation with high peak power of 2.6W and corresponding pulse duration of 3.2ps is achieved from a monolithic passively mode-locked gain guided tapered laser diode, based on an InGaAs quantum-dot structure. The possibility of generating picosecond pulses directly from this tapered laser with an average power up to 170mW is also demonstrated.

40. M. Butkus, C. J. Hamilton, D. Jackson, G. PA Malcolm, I. Krestnikov, D. Livshits and E. U. Rafailov, “GREEN SECOND HARMONIC GENERATION IN QUANTUM DOT SEMICONDUCTOR DISC LASERS” , 14th International Conference "Laser Optics 2010", St.Petersburg, Russia
Link: n/a
Abstract:
Conventional optically pumped semiconductor disk lasers (OP-SDLs) are able to produce laser light at a wide range of wavelengths across the visible and near infra-red spectrum with high output power and diffraction limited beam whilst allowing various intracavity techniques to be exploited. However due to the material characteristics of the conventional quantum well (QW) based SDLs a range of wavelengths, have been difficult to achieve. Therefore recently SDL architecture has been combined with novel quantum dot (QD) based gain materials to exploit their advantages provided by three dimensional carrier confinement and to extend the spectral coverage of SDLs using well established III-V semiconductor alloys. Up to date QD SDLs were reported to cover spectral region between 716 nm and 1270 nm. Visible region was reached by second harmonic generation to orange light using two gain chips recently [5]. In this paper we report a green light generation from intracavity frequency doubled QDs based SDL. By our knowledge, it is the first demonstration of intracavity frequency doubled QD SDL using a single gain chip. The laser is operating at 514 nm and therefore it is a potential alternative for the argon ion laser at this wavelength. Output power of nearly 2 W of green light was achieved.

41. C. J. Hamilton, G. Robertson, D. Jackson, G. P. A. Malcolm, R. A. Hogg, Y. Qiu, T. Walther, B. J. Stevens, P. A. Houston, A.B. Krysa, M. Butkus, E. U. Rafailov, “QUANTUM DOT SESAM FOR MODE-LOCKING OPERATION OF A TI:SAPPHIRE LASER AT 2 GHz”, 14th International Conference "Laser Optics 2010", St.Petersburg, Russia
Link: n/a
Abstract:
High-repetition-rate short-pulse lasers have an increasing number of applications including optical clocking of electronic circuits, optical coherent communication, optical metrology, telecommunications, optical data processing, sensing etc. In solid state lasers there are two techniques which are commonly used for mode-locking. These are semiconductor saturable absorber or intensity dependent effects in the gain material such as Kerr lensing. Demonstrations of saturable absorber mode-locking in solid state materials at high repetition rates (>1GHz) has been limited to wavelengths greater than 1μm. Saturable absorber mode-locking of VECSEL structures has been demonstrated at wavelengths as short as 960 nm. This is due to the difficulty in designing a semiconductor modelocker with the correct parameters for mode-locking below

870 nm and the relatively high saturation fluence of materials like Ti:sapphire compared to VECSELs. In this paper we report the demonstration of mode-locking in Ti:sapphire laser at 800 nm using a quantum dot modelocker (QDM), also known as quantum dot based semiconductor saturable absorber mirror (SESAM). We have shown that the QDM can support mode-locking over a wide range of repetition rates, namely 100 MHz to 2GHz while producing useful output powers of >400 mW. Pulse widths up to 7 ps were achieved.

42. M. Hoffmann, W.P. Pallmann, O.D. Sieber, V.J.Wittwer, Y. Barbarin, T. Suedmeyer, U. Keller, I.L. Krestnikov, S.S. Mikhrin, D.A. Livshits, G. Malcolm, C. Craig, "All Quantum-Dot Based SESAM modelocked VECSEL with sub-picosecond Pulses", 4th EPS-QEOD EUROPHOTON CONFERENCE, University of Hamburg, Germany
Link: n/a
Abstract:
QD-layers offer a larger design freedom for ultrafast VECSELs than standard quantum wells. We demonstrate the first modelocked VECSEL with QD-layers both for gain and saturable absorber at an emission wavelength of 960nm, achieving 780-fs pulses at 63mW.

43. K. A. Fedorova, M. A. Cataluna, I. L. Krestnikov, D. A. Livshits, and E. U. Rafailov, "202nm continuous tuning from high-power external-cavity InAs/GaAs quantum-dot laser", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract: Record broadly tunable high-power external cavity InAs/GaAs quantum-dot diode laser is demonstrated. A maximum output power of 455mW and a side-mode suppression ratio >45dB in the central part of the tuning range are achieved.

44. Y. Barbarin, W. P. Pallmann, M. Hoffmann, I. Dahhan, P. Kreuter, M. Golling, T. Südmeyer, B. Witzigmann, and U. Keller "Electrically-Pumped VECSELs Suitable for Passive Modelocking: Design, Simulation and Characterization in Continuous Wave", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract:
An ultrafast electrically-pumped VECSEL design requires adjustments between electrical resistance, optical losses, dispersion and cw output power. Validating our simulations with homogeneous current injection in large devices, 120 mW cw output power are generated.

45. M. Ruiz, N. Michel, M. Calligaro, Y. Robert, M. Krakowski, D. Nikitichev, M. A. Cataluna, D. A. Livshits, and E. U. Rafailov, "New Tapered Quantum-Dot Mode-Locked Laser Diode with High Peak Power, Low Divergence and Good Beam Quality", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract:
With a fully gain guided quantum-dot tapered laser diode we demonstrate stable low beam divergence, high beam quality together with a

record peak power of 2.6W under passive mode locking.

46. S. Breuer, M. Rossetti, W. Elsäßer, L. Drzewietzki, P. Bardella, I. Montrosset, and M. Hopkinson, "Reverse Ground-State Excited-State Emission Transition Dynamics in Two-Section Quantum Dot Semiconductor Lasers: Simultaneous Two-State Mode-Locking and State-Switching via a Resistor Self-Electro-Optic Effect Device (SEED)", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract:
Reverse emission-state transition and simultaneous two-state mode-locking in a two-section quantum dot semiconductor laser is demonstrated. By exploiting a resistor Self-Electro-optic Effect Device (SEED) configuration novel state-switched mode-locking and full emission state control is realized.

47. M. Butkus, J. Rautiainen, O. G. Okhotnikov, S. S. Mikhrin, I. L. Krestnikov, and E. U. Rafailov, "1270 nm Quantum Dot Based Semiconductor Disk Lasers", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract:
Continuous wave optically pumped semiconductor disk lasers based on Stranski-Krastanow grown quantum dots reach 1270nm for first time with the output power up to 1.6 W. Samples with different numbers of QD layers are compared.

48. M. Butkus, C. Hamilton, G. Malcolm, I. L. Krestnikov, D. A. Livshits, and E. U. Rafailov, "Wavelength Tuning In Quantum Dot Semiconductor Disc Lasers", ISLC 2010 The 22nd IEEE International Semiconductor Laser Conference, Kyoto, Japan
Link: n/a
Abstract:
Wavelength tuning results are reported for two quantum dot based semiconductor disk lasers. Broad tuneability of 50nm and 35nm is observed around emission wavelengths of 1040nm and 1260nm with hundreds of mWs output powers.

2011

49. Yohan Barbarin , "Recent advances in electrically pumped VECSELs for Modelocking" *(Invited Paper)*, SPIE Photonics West 2011

50. ,Wolfgang P. Pallmann, Martin Hoffmann, Michael Miller, Johannes Baier, Holger Moench, Imad Dahhan, Bernd Witzigmann, Matthias C. Golling, Yohan Barbarin, Thomas Südmeyer, Ursula Keller, "Beam quality optimization of electrically pumped VECSELs for passive modelocking", SPIE Photonics West 2011

51. Oliver D. Sieber, Martin Hoffmann, Valentin J. Wittwer, Wolfgang P. Pallmann, Yohan Barbarin, Matthias C. Golling, Thomas Südmeyer, Ursula Keller, “Scaling high-power ultrafast VECSELs into the femtosecond regime”, SPIE Photonics West 2011

52. Valentin J. Wittwer, Wolfgang P. Pallmann, Andreas E. H. Oehler, Benjamin Rudin, Matthias C. Golling, Yohan Barbarin, Thomas Südmeyer, Ursula Keller, “Timing jitter characterization of a quantum dot SESAM modelocked VECSEL”, SPIE Photonics West 2011

53. Martin Hoffmann, Oliver D. Sieber, Wolfgang P. Pallmann, Valentin J. Wittwer, Yohan Barbarin, Thomas Südmeyer, Ursula Keller, Igor L. Krestnikov, Sergey S. Mikhrin, D. A. Livshits, Graeme Malcolm, Craig Hamilton, “All quantum dot based femtosecond VECSEL”, SPIE Photonics West 2011

54. Rodrigo A. Aviles-Espinosa, Giorgos Filippidis, Craig Hamilton, Graeme Malcolm, Thomas Südmeyer, Yohan Barbarin, Ursula Keller, David Artigas-García, Pablo Loza-Alvarez, “Compact ultrafast semiconductor disk laser for nonlinear imaging in living organisms,” SPIE Photonics West 2011

55. Rodrigo A. Aviles-Espinosa, Susana I. C. O. Santos, Andreas Brodschelm, Wilhelm G. Kaenders, Cesar Alonso-Ortega, David Artigas-García, Pablo Loza-Alvarez, “In-vivo third-harmonic generation microscopy at 1550 nm: threedimensional long-term time-lapse studies in living C. elegans embryos”, SPIE Photonics West 2011

56. Omar E. Olarte, Susana I. C. O. Santos, Manoj Mathew, Sotiris Psilodimitrakopoulos, Pablo Loza-Alvarez, “Evaluation of the collateral damage during a femtosecond-laser axotomy by using a multimodal microscopy workstation”, SPIE Photonics West 2011

57. Edik U. Rafailov, Svetlana A. Zolotovskaya, Mantas Butkus, “QD-based saturable absorbers for ultrafast lasers” *(Invited Paper)*, SPIE Photonics West 2011

59. D. I. Nikitichev, M. A. Cataluna, Y. Ding, K. A. Fedorova, I. Krestnikov, D. Livshits, E. U. Rafailov, “High-power spectral bistability in a multi-section quantum-dot laser under continuous-wave or mode-locked operation”, CLEO/QELS: 2011

58. Y. Ding, D. I. Nikitichev, I. Krestnikov, D. Livshits, M. A. Cataluna, and E. U. Rafailov, “Fundamental and harmonic mode-locking with pulse repetition rate between 200 MHz and 6.8 GHz in a quantum-dot external-cavity laser”, CLEO®/Europe-EQEC 2011

59. D.I. Nikitichev, M. Ruiz, Y. Ding, M. Tran, Y. Robert, M. Krakowski, M. Rossetti, P. Bardella, I. Montrosset, I. Krestnikov, D. Livshits, M.A. Cataluna, and E.U. Rafailov, “Passively mode-locked monolithic two-section gain-guided tapered quantum-dot lasers: II. Record 15Watt peak power generation”, CLEO®/Europe-EQEC 2011

60. K. A. Fedorova, M. A. Cataluna, P. R. Battle, I. Krestnikov, D. Livshits, E. U. Rafailov, “Broadly tunable CW green-to-red laser source based on frequency doubling of a quantum-dot external cavity diode laser in a PPKTP waveguide”, CLEO®/Europe-EQEC 2011

61. M. Hoffmann, O. D. Sieber, V. J. Wittwer, W. P. Pallmann, I. L. Krestnikov, S. S. Mikhrin, D. A. Livshits, M. Golling, Y. Barbarin, T. Südmeyer and U. Keller, “Femtosecond VECSELs with up to 1 W Average Output Power”, CLEO®/Europe-EQEC 2011

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66. E.Jelmakas, R.Tomašiūnas, M.Vengris, E.Rafailov, I.Krestnikov, “Photoinduced Transmittance at 1250 nm of InAs/InGaAs Quantum Dot Based Semiconductor Optical AmplifierMeasured via Waveguiding Configuration”, 13th International Conference on Transparent Optical Networks (ICTON 2011)

67. E. Jelmakas, R.Tomašiunas, M.Vengris, E.Rafailov, I.Krestnikov, “Investigation of photoinduced transmittance in InAs/InGaAs quantum dot based waveguiding semiconductor optical amplifiers”, Lithuanian National Conference on Physics 2011

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69. Mario Mangold, Valentin J. Wittwer, Oliver D. Sieber, Martin Hoffmann, Matthias C. Golling, Thomas Südmeyer, Ursula Keller, “Characterization of gain parameters in quantum-dot and quantum-well based VECSEL structures”, SPIE Photonics West 2012 LASE

70. Valentin J. Wittwer, Robbert van der Linden, Bojan Resan, Kurt J. Weingarten, Thomas Südmeyer, Ursula Keller, “Sub-80-fs timing jitter of a stabilized SESAM modelocked VECSEL”, SPIE Photonics West 2012 LASE

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76. Bojan Resan, Felix Brunner, Andreas Rohrbacher, Hubert Ammann, Kurt J. Weingarten, “Low noise laser system generating 27-fs pulse duration, 30-kW peak power, and tunability from 850 to 1250 nm for ultrafast spectroscopy and multiphoton microscopy”, SPIE Photonics West 2012 LASE

77. Bojan Resan, Felix Brunner, Andreas Rohrbacher, Hubert Ammann, Kurt J. Weingarten, “Low-cost laser system exhibiting 27 fs pulse duration, 30 kW peak power, and tunability from 850 to 1250 nm for multiphoton microscopy”, SPIE Photonics West 2012 BIOS

78. Valentin J. Wittwer, “High average power modelocked VECSELs and MIXSELs”, 1st DYCE-Asia Workshop 2012

79. D.I.Nikitichev, “High-power spectral bistability in a multi-section quantum-dot laser under continuous-wave or mode-locked operation”, CLEO US 2012

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81. Christian A. Zaugg, “Sub-GHz Pulse Repetition Rates from a Modelocked VECSEL”, CLEO US 2012

82. D. I. Nikitichev, K. A. Fedorova, Y. Ding, A. Alhazime, A. Able, W. Kaenders, I. Krestnikov, D. Livshits, E. U. Rafailov, “Broadly tunable picosecond pulses quantum-dot modelocked laser”, Laser Optics 2012

83. K.A. Fedorova, G.S. Sokolovskii, D.I. Nikitichev, P.R. Battle, I.L. Krestnikov, D.A. Livshits, E.U. Rafailov, “Tunable Visible SHG in CW and Picosecond Regimes”, Laser Optics 2012

84. C.A.Zaugg, M.Hoffmann, W.P.Pallmann, V.J.Wittwer, M.Golling, K.J.Weingarten, T.Südmeyer, U.Keller, “250 MHz Modelocked VECSEL: Towards Low Repetition Rates Using an Extendable Multi-Pass Approach”, 5th EPS-QEOD Europhoton Conference 2012

85. O. D. Sieber, M. Mangold, V. J. Wittwer, M. Hoffmann, M. Golling, T. Südmeyer and U. Keller, “ Experimentally verified pulse formation model for high-power femtosecond vertical emitting semiconductor lasers”, 5th EPS-QEOD Europhoton Conference 2012