8:00 a.m.–9:45 a.m.
CTuA • Pulse Synthesis and Timing
François Légaré; INRS-EMT, Canada, Presider

CTuA1 • 8:00 a.m.
Multi-Heterodyne Characterization of Multi-
Gigahertz Spaced Optical Frequency Comb
Sources, Josue Davila-Rodriguez, Charles
Williams, M. Mohammadi Akhshai, Peter J. Delfyett,
CREOL, College of Optics and Photonics, Univ. of
Central Florida, USA. Mixing products between
frequency combs with detuned repetition rates
are used to characterize multi-gigahertz spaced
optical frequency combs generated from mode-
locked semiconductor lasers. Time domain RF
waveform measurements show effective sampling
of the optical waveform.

CTuA2 • 8:15 a.m.
Direct Feed-Forward Scheme for Frequency
Combos with Arbitrary Offset and Shot-Noise
Limited Phase Noise, Sebastian Kohl, Christian
Grebing, Harald Frei, Manfred Riemer, Andreas
Axion, Günter Steinmeyer2, Max Born Inst, Ger-
macy, Femtolasers Produktion GmbH, Austria.
We propose and demonstrate a novel feed-forward
scheme for stabilizing the carrier-envelope-
offset frequency of a mode-locked laser at unpre-
cedented residual noise levels. This method allows
for comb synthesis at arbitrary offset frequencies,
including zero offset.

CTuA3 • 8:30 a.m.
Generation of Compressed Optical Pulses be-
yond 160 GHz Based on Two Injection-Locked
CW Lasers, Francesca Parmigiani1, Radan
Starik, Richard Peters2, Pirlotis Petropolous3, James
O’Gorman4, David J. Richardson5; Optoelec-
tronics Res. Ctr., Univ. of Southampton, UK, M2
Bournes Ltd, Ger.
A novel technique is applied to the generation
of optical frequency combs with arbitrary
residual offsets. Two injection-locked CW
lasers are coupled together, forming a single
motorized source. The output contains
sub-100 fs pulses with a tunable frequency
offset from 0 to 160 GHz. The method allows
for the generation of sub-10 fs pulses with
a tunable frequency offset from 0 to 160 GHz.

CTuA4 • 8:45 a.m.
Supermode Noise Spur Suppression and
Frequency Comb Generation in a 100 MHz
Semiconductor-Based Theta-Cavity Laser Using
an In-Cavity Fabry-Pérot Etalon, Dimitrios
Dimitrakos, Marco Baggett, Ibrahim Ozturk, Peter
J. Delfyett, CREOL, College of Optics and Photon-
ics, Univ. of Central Florida, USA.
A Fabry–Pérot etalon is inserted into a semiconductor-based laser
operating at the clamped pulse amplification
mode. The output exhibits whenever
spur suppression and a semiconductor-based opti-
cal frequency comb is generated.

CTuB • 8:45 a.m.
Chemical/Biological/
Medical Sensing

CTuB1 • 8:00 a.m.
Modulation-Frequency Encoding/Decoding
for Parallel Detection in Biophotonic Sensing,
Chantaya Dongre, Markus Pohlmann, Hugo J. W.
Hockstra, Integrated Optical Microsystems
(IOMS), MESA+ Inst. for Nanotechnology, Univ.
of Twente, Netherlands. Fluorescence from differ-
ten emitters (labeled biomolecules) with distinct
absorption wavelengths is encoded by uniquely
modulating each excitation beam. Detection by an
ultrasensitive, albeit color-blind photomultiplier
and subsequent Fourier analysis reveals the origin
of each signal.

CTuB2 • 8:15 a.m.
Cancellation Method for Detection
of Molecules with Unresolved Absorption
Bands, Antonio A. Kowal1, David Thomazy2, Leong,
Frank K. Tittel3, Vincenzo Spagnolo4; Rice Univ., USA.2
Univ. and Politecnico of Bari, Italy.
A novel spectroscopic technique was applied
to detection of hydrazine vapor using two wide
stripe diode lasers and a variation of QFIRAS.
Modulating lasers with 180 degrees phase shift
resulted in >100 times background reduction.

CTuB3 • 8:30 a.m.
Photofragmentation Approaches for the
Detection of Polyatomic Molecules, Thomas
A. Reichardt, Alexandra A. Hoops, Jeffrey M.
Hendrick, Roger L. Farrow, Thomas B. Settles,
Scott E. Bissel, Thomas J. Kulp, Sandia Natl.
Labs, USA. We review three photofragmentation
detection approaches, describing the detection (1)
spatially resolved absorption and photofrag-
mation emission, (2) spatially resolved absorption
compounds by photofragmentation-ionization,
(3) surface-bound organophosphate com-
ounds by photofragmentation-laser-induced
fluorescence.

CTuB4 • 8:45 a.m.
Optical Biosensors for Chemical
Detection, Mark W. Zolper1,2; 1Univ. of California
at Santa Cruz, USA, 2Univ. of California at Santa Cruz,
USA.
We review optical biosensors for chemical
detection, including optical sensors for
the detection of bioanalytes in aqueous
and biological matrices. The sensors
employed include surface plasmon
resonance, surface enhanced
Raman scattering, and
optical waveguide
biosensors.

CTuC • 8:00 a.m.
High Power Fiber Lasers
John Minelly, Coherent, Inc., USA, Presider

CTuC1 • 8:00 a.m.
Recent Progress and Limiting Factors in High
Power Fiber Laser Technology, Johan Nilsson,
Univ. of Southampton, UK. This tutorial discusses
the recent rapid progress of high-power fiber
sources, selected state-of-the-art devices in differ-
ent regimes of operation, the technology limits to
further progress, and possible routes forward.

CTuC2 • 8:15 a.m.
Optical Control of Neural Activity with Amor-
phous Silicon Light Addressable Electrodes, Han-
yin Hsu, Hakan Lee, Arash Jamshidi, Austin
Valley, Shao Ning Pei, Ehud Isacoff, Ming C. Wu;
Univ. of California at Berkeley, USA. We present an
optically addressed electrical stimulation device
for neuron control with single cell resolution and
millisecond temporal resolution. This system allows
dynamic study of interconnected neural
network at single neuron level.

CTuC3 • 8:30 a.m.
Dual-Color Fluorescence Cross Correlation
Spectroscopy on an Integrated Optofluidic
Chip, Aiqing Chen1, Milhail I. Rudenko1, Evan
J. Lunt1, Brian S. Phillips1, Aaron Hawkins1, Holger
Schmidt2, Univ. of California at Santa Cruz, USA.
We present an integrated optofluidic chip with
dual-color fluorescence correlation spectroscopy.

CTuC4 • 8:45 a.m.
Surface Enhanced Raman Scattering (SERS)
on-an-Optofluidic Chip Using Rofl Collapse
Method, Jianjun Cao, Yan Sun Hall, David
Ericson1,2, Carmel Univ., USA, 2Dep. of Materials
Here we demonstrate a SERS optofluidic device us-
ing a nanochannel fabrication method developed
by our group. This device consists of nanochannels
and a SU-8 waveguide. As a test we demonstrate
the detection of SERS-active Rhodamin6G.
Optical Processing Group INRS-EMT, Canada, Tantalate with random mark-to-space ratio. tric crystals, such as periodically poled Lithium of domain distribution in bulk quadratic ferroelectric, and test a simple approach for the characterization of 2DIEET, Univ. of Palermo, Italy, 3NooEL-Nonlinear Science of Light, Germany, 2Ctr. for Photonics and Engineering phase matching, enabling efficient parametric generation at arbitrary frequencies of distributed-feedback interband cascade lasers, have been demonstrated to operate at temperatures as high as 40°C with 1 mW of power at 3.2 μm Single Spatial Mode Diode Lasers Operating at Room Temperature, Alexander Soibel, William W. Bewley, Chadwick L. Cade, Chuan Zhou, Seungho Kim, J. R. Lindle, Jonathan D. Abd, Igor Vervueren, and Jerry R. Meyer, NRL, USA. We report corrugated-sidewall distributed-feedback interband cascade lasers that produce 45 mW of cw power in a single spectral mode at -20°C, with maximum wall-plug efficiency of 7.8%. The current tuning range (0-20°C) is 11 nm. We demonstrate efficient generation of a Raman-type optical frequency comb by employing adiabatic Raman-excitation in an enhancement cavity. A broad frequency-comb spanning over 130 THz is realized with an excitation-power well over 1 kW, achieved by using a ridge waveguide type-I quantum well GaAs-based diode lasers, with active regions utilizing InGaAs/AlInGaAs quantum wells, have been demonstrated to operate at temperatures as high as 40°C with 1 mW of power at wavelengths above 3.2 μm. The current tuning range (0-20°C) is 11 nm. We present a novel scheme for freely engineering phase matching, enabling efficient parametric generation at arbitrary frequencies in mechanically compliant nano-optomechanical structures. Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Room A8  Room C1&2  Room C3&4  Joint  Room CLEO

8:00 a.m.–9:45 a.m.  

CTuF1 • 8:00 a.m.  
5-D Stand-up Metamaterials With A Purely Magnetic Resonance At Terahertz Frequencies, Kehin Fan, Andrew Strikwerda, Hu Tao, Xiu Zhang, Richard Averitt; Boston Univ., USA. 3-D stand-up metamaterial with purely magnetic resonance at THz frequencies was demonstrated and characterized. The successful design, fabrication and characterization of 5-D metamaterials provides a new pathway for implementing novel electromagnetic properties at terahertz frequencies.

CTuF2 • 8:15 a.m.  
Concentration of Terahertz Radiation Through Tapered Circular Subwavelength Apertures, Tho Duc Nguyen, Z. Vah Vardeny, Ajay Nahata; Univ. of Utah, USA. We demonstrate the concentration of broadband terahertz radiation through conically tapered subwavelength apertures. Concomitantly, there is a reduction of the THz group velocity for the transmitted pulse. We describe the underlying principle behind this phenomenon.

CTuF3 • 8:30 a.m.  
Structurally Reconfigurable Metamaterials at Terahertz Frequencies, Hu Tao, Andrew C. Strikwerda1, Kehin Fan1, Willie J. Padilla1, Xiu Zhang1, Richard D. Averitt2; Boston Univ., USA, 2Boston College, USA. We demonstrate structurally reconfigurable metamaterials with a marked tunability of both electric and magnetic responses at terahertz frequencies where artificial atom reorient within unit cells in response to an external stimulus.

CTuF4 • 8:45 a.m.  
Terahertz Surface Waves on a Split Ring-Based Metamaterial Film, Benjamin Reinhard1, Olivier Paul2, René Beigang1, Marco Rahm1; 1Univ. of Kaiserslautern, Germany, 2Fraunhofer Inst. for Physical Measurement Techniques IPM, Germany. We present experimental and numerical investigations on the excitation and dispersion characteristics of resonant terahertz surface waves on thin metamaterial films. An intuitive model is introduced which describes the material as a thin slab waveguide.

Room C3&4  Joint  Room CLEO

8:00 a.m.–9:45 a.m.  

CTuG1 • 8:00 a.m.  
New Frontiers of Organic Electro-Optic Materials and Devices: From Molecular Engineering to Technological Innovations, Alex Jere1, Univ. of Washington, USA. Abstract not available.

CTuG2 • 8:30 a.m.  
Optically Patterned Liquid Crystal Devices for High-Resolution Beam Shaping, Maria Vargas, Zeyu Zhao, Kenneth L. Marshall, Christophe Derre1, Lab for Laser Energetics, USA. Achromatic laser-beam shapers employing spatially varying twisted nematic liquid crystals (LCs) have been demonstrated for high-peak-power applications. The LC molecular orientation was achieved through photolithographic patterning of an alignment layer using polarized UV light.

CTuG3 • 8:45 a.m.  
Gaussian to Lorentzian Beam Profile Converter Based on Conical Refraction, Amin Abdolvand1, Keith G. Wilson1, Todor K. Kalkandiev2, Yuri Loiko3, Jordi Mompart3, Edik U. Rafailov1; 1Boston Univ., USA, 2Boston College, USA, 3Universitat Autònoma de Barcelona, Spain. We employ conical refraction crystal for one-step conversion of an incident beam with Gaussian transverse intensity profile to a beam of Lorentzian profile with less divergence in free space than the original Gaussian beam.

San Jose Ballroom IV  San Jose Marriott  Room CLEO

8:00 a.m.–9:45 a.m.  

JTuA1 • 8:00 a.m.  
High Resolution 3-D Laser Direct-Write Processing, Tommaso Baldacchini, Newport Corp., USA, Presider.

JTuA2 • 8:30 a.m.  
In Situ Monitoring of Two-Photon Polymerization Using Broadband CARS Microscopy, Tommaso Baldacchini, Robert Zadeyan, Newport Corp., USA. We present a method for monitoring in-situ TPP using broadband CARS microscopy. Since both fabrication and imaging are performed using the same experimental setup, characterization of polymeric microstructures with structural information is attained rapidly.

JTuA3 • 8:45 a.m.  
Two-Photon Polymerization of Dielectric-Loaded Surface Plasma-Polariton Nanowaveguides, Yan Li1, Hao Luo, Haibo Cui, Hong Yang, Qihuang Gong; Peking Univ., China. Dielectric-loaded surface plasma-polariton nanowaveguides on the gold film are fabricated by two-photon polymerization with femtosecond laser pulses. The leakage radiation microscopy shows that they are single-mode with strong mode confinement at 830 nm.

JTuH1 • 8:00 a.m.  
Light Trapping Crystals have applications ranging from solar energy harvesting to on-chip optical information processing and offer a new strong, coupling regime for light-matter interactions. I review their physics, their microfabrication, and applications.

JTuH2 • 8:15 a.m.  
Review their physics, their microfabrication, and applications.

JTuH3 • 8:30 a.m.  
Light trapping crystals have applications ranging from solar energy harvesting to on-chip optical information processing and offer a new strong, coupling regime for light-matter interactions. I review their physics, their microfabrication, and applications.

Sajeev John is a “University Professor” at the University of Toronto and Government of Canada Research Chair. He received his Bachelor degree in physics in 1979 from the Massachusetts Institute of Technology and his Ph.D. in physics at Harvard University in 1984. His Ph.D. work at Harvard originated the theory of classical wave localization and in particular the localization of light in three-dimensional strongly-scattering dielectrics. From 1986-1989 he was an assistant professor of physics at Princeton University. While at Princeton, he co-invented (1987) the concept of photonic band gap materials, providing a systematic route to his original conception (1984) of the localization of light. In 1989 he joined the senior faculty at the University of Toronto. Professor John is the winner of the 2001 King Faisal International Prize in Science, together with C. N. Yang. He is the first ever winner of Canada’s Platinum Medal for Science and Medicine in 2002. Dr. John received the Institute of Electrical and Electronic Engineers (IEEE) LEOS International Quantum Electronics Award in 2007 for “the invention and development of light-trapping crystals and elucidation of their properties and applications” and most recently the 2008 IEEE Nanotechnology Pioneer Award.
Cells with Textured Photonic Back Reflector, Enhanced Absorption in Thin Film Si Solar Cells
K. A. Broderick, Cells with Textured Photonic Back Reflector, Enhanced Absorption in Thin Film Si Solar Cells, JTuB2 • 8:30 a.m.

K. A. Broderick; Cornell Univ., USA, 2New York Univ. and CUNY Graduate Ctr., USA, 3Shanghai Inst. of Microsystems and Information Technology, China.

1MIT, USA, 2New York Univ. and CUNY Graduate Ctr., USA, 3Shanghai Inst. of Microsystems and Information Technology, China.

Next-Generation Solar Cells, Jeff Sauer; Cornell Univ., USA, Presider

Enhanced Absorption in Thin Film Si Solar Cells with Textured Photonic Back Reflector, K. A. Broderick1, L. Zeng1, B. A. Alamar1, X. Du1, Z. Zou1, J. Zhou1, X. Bai1, Yashu Li2,3, J. Tu2,3,4, A. A. Alamar1,3; MIT, USA, New York Univ. and CUNY Graduate Ctr., USA, Shanghai Inst. of Microsystems and Information Technology, China.

We present the design, processing and characterization of Si-on-insulator thin film solar cells integrated with textured photonic backside reflector. Cells at all thicknesses demonstrated significant external quantum efficiency (EQE) enhancement due to the back reflector.

Enhanced Absorption and Light Trapping Regimes in Thin Film Silicon Solar Cells with a Photonic Pattern, Simone Zanotto, Marco Lisdì, Luca Claudio Andreani, Univ. degli Studi di Pavia, Italy. By patterning thin-film silicon solar cells with a periodic etching in addition to an AR coating, we increase the short-circuit current up to 36.5%. The pattern and the coating are investigated to recognize different coupling regimes.

8:30 a.m.–9:45 a.m.
JTuB • Novel Materials for Enhanced Solar Cell Performance
Clifford R. Pollock; Cornell Univ., USA, Presider

JTuB1 • 8:00 a.m. • Invited
Clifford R. Pollock; Cornell Univ., USA, Presider
Next-Generation Solar Cells, Clifford R. Pollock; Cornell Univ., USA, Presider

Performance for Enhanced Solar Cell Concepts, Vladimir Y. Shkunov; Raytheon Corp., USA, Presider

JTuB1 • 8:00 a.m. • Invited
Vladimir Y. Shkunov; Raytheon Corp., USA, Presider

Multi-Junction Solar Cells with Nanomembrane for Enhanced Absorption, Android Zambuch, Günter Krauss, Tobias Henke, Alexander Sell, Daniel Triadis, Alfred Lasserty, Univ. of Konstanz, Germany. A widely tunable picosecond Er fiber laser system enables fast and turn-key CARS microscopy. The tuning range gives access to vibrational resonances between 1150 cm⁻¹ and 3800 cm⁻¹ with high spectral resolution of 10 cm⁻¹.

8:00 a.m.–9:45 a.m.
CTuI • Advanced Solid-State Concepts
Eric Honea; Lockheed Martin Aculight, USA, Presider

CTuI1 • 8:00 a.m. • Invited
Diamond Raman Lasers, Richard P. Middlen, A. Sabella, E. Gnelius, D. J. Spence; MO Photonics Res. Ctr., Macquarie Univ., Australia. We summarize our recent research in Raman lasers based on undoped single crystal diamond. Highly efficient visible cavity lasers operating in nanosecond and picosecond regimes are reported.

Intracavity Diamond Raman Lasers, Walter Loebig, Gerald M. Burner, Jennifer E. Hastie, Martin D. Dawson, David Burns, Alan J. Kemp; Inst. of Photonics, UK. A synthetic diamond crystal was used inside a Nd:YVO₄ laser cavity as a Raman gain medium. A maximum average power of 120mW at 1240nm was measured.

CTuI2 • 8:30 a.m. Intracavity Diamond Raman Lasers, Walter Loebig; Aculight, USA, Presider

CTuI2 • 8:30 a.m. Intracavity Diamond Raman Lasers, Walter Loebig1, Andrew Kelly2, Vassili Savitsky1, Joao Gomes2, Gordon Brown1, Deepak Uttamchandani1, David Burns1, Inst. of Photonics, UK. We report on a simple all-fiber coherent anti-Stokes Raman scattering (CARS) source capable of multiplex operation out to detunings in excess of 2500 cm⁻¹. The CARS-spectra of several molecules are measured with this system.

Intracavity MEMS Lasers, Walter Loebig1, Andrew Kelly2, Vassili Savitsky1, Joao Gomes2, Gordon Brown1, Deepak Uttamchandani1, David Burns1; Inst. of Photonics, UK. Intracavity low-cost scanning MEMS micromirrors are used to control the output beam of Nd:YVO₄ lasers. Successful Q-switching was achieved with pulse durations of 200ns.

CTuI3 • 8:45 a.m. Intracavity MEMS Lasers, Walter Loebig1, Andrew Kelly2, Vassili Savitsky1, Joao Gomes2, Gordon Brown1, Deepak Uttamchandani1, David Burns1; Inst. of Photonics, UK. We present the design, processing and characterization of Si-on-insulator thin film solar cells integrated with textured photonic backside reflector. Cells at all thicknesses demonstrated significant external quantum efficiency (EQE) enhancement due to the back reflector.

CTuI3 • 8:45 a.m. Intracavity MEMS Lasers, Walter Loebig1, Andrew Kelly2, Vassili Savitsky1, Joao Gomes2, Gordon Brown1, Deepak Uttamchandani1, David Burns1; Inst. of Photonics, UK. We present the design, processing and characterization of Si-on-insulator thin film solar cells integrated with textured photonic backside reflector. Cells at all thicknesses demonstrated significant external quantum efficiency (EQE) enhancement due to the back reflector.

CTuI4 • 8:45 a.m. Coherent Anti-Stokes Raman Scattering Microscopy Based on a Compact Two-Color Er Fiber Laser, Remo Seilm, Martin Winterhaldner, Andreas Zambuch, Günter Krauss, Tobias Henke, Alexander Sell, Daniel Triadis, Alfred Lasserty; Univ. of Konstanz, Germany. A widely tunable picosecond Er fiber laser system enables fast and turn-key CARS microscopy. The tuning range gives access to vibrational resonances between 1150 cm⁻¹ and 3800 cm⁻¹ with high spectral resolution of 10 cm⁻¹.

Additional information:
- Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
- NO CAMERAS
Tuesday, May 18

Room A1

10:00 a.m.–5:00 p.m. Exhibit Open, San Jose McEnery Convention Center, Exhibit Halls 1 and 2

10:00 a.m.–10:30 a.m. Coffee Break, San Jose McEnery Convention Center, Exhibit Halls 1 and 2

CLEO/QELS & CLEO: Applications and CLEO: Expo • May 16–21, 2010
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Continued

**CTuF • HZ Metamaterials—Continued**

CTuF5 • 9:00 a.m.

Optimum Coverage for Perfect Transmission in 2-Dimensional Metallic Arrays, Jong Woong Lee1, T. H. Park2, Peter Nordlander1, Daniel Mittleman3, Nanophotonics Lab, Advanced Photonics Res. Inst., GIST, Korea Republic of, Rice Univ., USA. We demonstrate optimum coverage in the enhanced transmission of terahertz radiation through 2-dimensional metallic arrays of square holes with different periodicity changing along the direction perpendicular to the incident polarization.

CTuF6 • 9:15 a.m.

Chiral THz Metamaterials with Tunable Optical Activity, Jangfeng Zhou1, Rongxiao Zhao1, Ceal M. Strikwerda1, Antoinette J. Taylor2, John O’Hara1; 1Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab., USA, 2Arizona State University, Tempe, AZ, USA. Tunable optical activity in chiral metamaterials is demonstrated in simulation and shows actively tunable giant polarization rotation over a wide frequency band.

CTuF7 • 9:30 a.m.

Transmission and Reflection Properties of Terahertz Fractal Metamaterials, Bads Malinovskii1, Andrei Lavinenko2, David G. Cottrell1, Peter U. Jepsen3, S. Xiao4; 1Technical Univ. of Denmark, Denmark, 2Tudan Univ., China. We use THz time-domain spectroscopy to investigate transmission and reflection properties of metallic fractal metamaterial structure. We observe loss of free-space energy at certain resonance frequencies, indicating excitation of surface modes of the metamaterial.

**CTuF • Beam Shaping and Switching—Continued**

CTuF4 • 9:00 a.m.

Tunable Cholesteric Liquid Crystal Diffraction Grating Based on the Effect of Localized Surface Plasmons, Wen-Chi Hung1, I-Min Jiang1, Tzu-Yao Wu1, Nan-Yi Su1, Shanshan Lin2, I-Min Jiang1; 1Dept. of Physics and Astronomy, Iowa State Univ., USA, 2National Taiwan University, Taiwan. Tunable cholesteric liquid crystals (CLC) diffraction grating based on the effect of localized surface plasmons (LSP) was investigated. To doping metal nanoparticle into the CLC grating, an particular diffraction was observed due to LSP effect.

CTuF5 • 9:15 a.m.

400 kHz Beam Scanning Using KTaO3, NH2O Crystals, Jun Miyasaka1, Tetsuro Suzuki1, Katsumori Naganuma1, Takaaki Imai1, Seiji Toyoda1, Tatsuya Yanagawa1, Masahiro Sano2, Shogo Yagi2; 1NTT Photonics Labs, Japan, 2NTT Advanced Technology, Japan. KTaO3, NH2O crystals are described. The scanning angle remains in the same up to 400kHz. Our proposed new scanning model supports this high-speed beam scanning.

CTuF6 • 9:30 a.m.

Spun-Coated Ge9-xNbxS70 Thin Films with Large Photo-Induced Refractive Index Change, Shunahom Song1, Nathan Carlie2, Laeticia Petit2, Nathan Carlie2, Laeticia Petit2, Kathleen Richardson2, Craig Arnold1; 1Princeton Univ., USA, 2Laser Application Technology Ctr., Industrial Technology Res. Inst. South, Taiwan. We have achieved a very narrow band and strong thermal radiation peak in a design wavelength by using interband transitions in quantum wells and two-dimensional photonic crystals.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Tuesday, May 18

### CLEO

**Room A1**

**CLEO • Ultrafast Sources**

**David M. Gaudiosi; Raydiance, Inc., USA, President**

**Room A2**

**CLEO • Cavity Enhanced Optical Forces and Sensing**

**Gustavo Wiebecheck; Cornell Univ., USA, President**

**Room A3**

**CLEO • Nonlinear Fiber Sources**

**Siddharth Ramachandran; Boston Univ., USA, President**

**Room A4**

**CLEO • Optofluidic Biosensors**

**Holger Schmidt; Univ. of California at Santa Cruz, USA, President**

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**CTuK1 • 10:30 a.m.**

Self-Starting Octave-Spanning Ti:Sapphire Laser Pumped by an Yb:KLu(WO₄)₂ Thin-Disk Oscillator, Stefan Rauch², Thomas Bonhammer¹, Guido Palmer³, Michael Jackstadt², Uwe Mörgert². Hannover, Germany, ²Ctr. for Quantum Engineering and Space-Time Res. (QUEST), Germany, ³VENCES Laser Technology GmbH, Germany, ⁴Laser Zentrum Hannover, Germany. We present an octave-spanning Ti:sapphire laser quasi-synchronously pumped by a frequency-doubled Yb:KLu(WO₄)₂ thin-disk oscillator. The system features a self-starting behavior and can be stabilized with respect to its carrier-envelope-offset phase.

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**CTuK2 • 10:45 a.m.**

Cryogenically Cooled cw-Pumped Double-Pass Ti:Sapphire Amplifier Emitting 1μJ Pulse Energies, Nils Pfaffmann¹,², Martin Sigel³, Stefan Rauch². Thomas Bonhammer¹, Uwe Mörgert⁻¹⁻¹. Inst. für Quantenoptik, Leibniz Universität Hannover, Germany, ²Ctr. for Quantum Engineering and Space-Time Res. (QUEST), Germany, ³Laser Zentrum Hannover, Germany. A double pass cw-pumped Ti:sapphire amplifier delivering 1.6μJ pulses at 1 MHz is presented. Furthermore a simple analytical model for the amplifier is deduced and concepts for further energy scaling are explored.

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**CTuK3 • 11:00 a.m.**

Dispersed Pumped Gigahertz Repetition Rate Femtosecond Cr:LiSaF Laser, Duo Li, Unit Demirbas, Jonathan R. Birge, Gale S. Petrich, Leslie A. Kolodziejski, Alphan Sennaroglu, Franz X. Kärner, James G. Fujimoto; MIT, USA. We report a low-cost, 1 GHz repetition-rate, diode-pumped, saturable Bragg reflectors mode-locked Cr:LiSaF laser, which generates nearly transform-limited 103-fs-long pulses around 866 nm, with a record high peak power of 1.45 kW.

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**CTuK4 • 11:15 a.m.**

Gas Ionization Induced Post-Compression of High Energy and Super-Intense Femtosecond Pulses, Dominique Decamps, Corinna Fertacam, Cécile Fournet-Dutin, Antoine Dubroca, Stéphane Petit, Eric Mivel, Eric Constant; Univ. de Bordeaux, France. From a 40 fs - 70 mJ terawatt Ti:sapphire laser, compression of pulses down to 11 fs (FWHM) with a total output energy of 13.7 μJ is achieved through rapid ionization of helium.

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**CTuK5 • 10:30 a.m.**

Photonic Crystal Defects with Increased Surface Area for Improved Refractive Index Sensing, Christopher Kang¹, Christopher Phase², Sharon M. Weiss³, Yuri A. Vlasov, Solomon Assefa⁴. Vanderbilt Univ., USA, ²IBM TJ Watson Res. Ct., USA. Photonic crystal cavities with tunable surface area via multiple-hole defects were investigated for increased resonance wavelength sensitivity to exposure to variable-index analytes. Sensitivity was improved by 10% compared to simulated L3 cavities.

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**CTuK6 • 10:45 a.m.**

Scattered Induced Mode Splitting in Active Microcavities, Lina He, Salim Kaye Oceider, Jiayun Zha, Lan Yang. Washington Univ. in St. Louis, USA. Scattering induced mode splitting in microcavities with gain medium is detected directly using heterodyne technique without wavelength scan around resonant modes. Optical gain helps resolve small mode splittings, which might be missed in passive microcavities.

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**CTuL1 • 11:00 a.m.**

Large Scale Array of Miniatured Microcavity Resonators for High Resolution On-Chip Spectroscopy, Zhicai Xia, Mohammad Soltani, Qing Li,回复youde, Yudong Chen, Mengtian Li, Xiaoyan Ren, Lin Yang. Washington Univ. in St. Louis, USA. We demonstrate detection and sizing of single nanoparticles down to 30 nm by monitoring the mode splitting induced by a nanoparticle in an ultra-high quality factor (Q> 25,000) on-chip spectroscopy with low insertion loss.

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**CTuL2 • 11:15 a.m.**

Detection and Sizing of Single Nanoparticles by Mode Splitting in an Optical Microresonator, Jiayang Zhu, Solih K. Oceider, Yuan-Feng Xiao, Lin Li, Lina He, Da-Ren Chen, Lan Yang. Washington Univ. in St. Louis, USA. We demonstrate detection and sizing of single nanoparticles by monitoring the mode splitting induced by a nanoparticle in an ultra-high quality factor (Q> 25,000) on-chip spectroscopy with low insertion loss.

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**CTuL3 • 11:00 a.m.**

High Power 55 Watts CW Raman Fiber-Gas Laser, Francoise Couvin, Phil S. Light, Brian J. Mangan, Fetah Benabid; Physics Dept., Univ. of Bath, UK. We present two compact multi-line Raman lasers based on two types of HC-PCF photonic microcells. Each discrete component of the laser exhibits high spectral power density and narrow linewidth for forensics and biomedical applications.

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**CTuL4 • 11:15 a.m.**

On-Chip Nanoplasmonic-Nanofluidic Biosensors Overcoming Mass Transport Limitations, Ahmet A. Yanik¹, Min Huang², Aylm A. Y. Chang³, Hatice Altug². ¹Boston Univ., USA, ²MIT, USA. We demonstrate a novel hybrid platform merging label free nanoplasmonic sensing with actively controlled nanofluidic surface delivery to overcome mass transport limitations. We show 14-fold improvement in mass transport rate constants appearing in the exponentials.

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**CTuN1 • 10:30 a.m.**

Label-Free Optofluidic Biosensing in Microplate, Microfluidic, and Spot-Based Affinity Capture Assays, Charles J. Choi, Alyssa R. Belohradchik, Leo L. Chen, Patrick C. Mathias, Brian T. Cunningham; Univ. of Illinois at Urbana-Champaign, USA. Use of crystal reflectance filters is co-fabricated/integrated with microfluidic channels or spot-based microarrays. Reaction rate constants measured, sensitivity limits and kinetic signal acquisition for label-free biosensing within various assay formats are studied.

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**CTuN2 • 10:45 a.m.**

Optofluidic Sizing with Flow-Through Plasmonic Nanohole Arrays, Carlos Escobedo, Alexandre G. Brous, Brian Gordon, David Sinton; Univ. of Victoria, Canada. Sizing potential and resulting improved analyte collection in flow-through nanohole array sensors is compared to planar SPR sensing. At typical flow rates, full analyte collection, reaction limited transport and atomtural critical concentrations can be achieved.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
**Room A8**

**10:30 a.m.–12:15 p.m.**

**CfUQ • THz Waveguides**
Welli Zhang, Oklahoma State Univ., USA, Presider

**CfUQ1 • 10:30 a.m.**
Subwavelength Confinement of THz Radiation in Tapered Plasmonic Slot Waveguides, Hsi Zhan, Rajind Mendis, Daniel Mittleman, Rice Univ., USA. We experimentally characterize the confinement of terahertz radiation in tapered slot waveguides. Both the transverse and axial field components exhibit strong lateral confinement. An antisymmetric axial field distribution is observed across the output gap.

**CfUQ2 • 10:45 a.m.**
Dispersion-Free 2-D Confined Terahertz Pulses Propagation in Gap Waveguide Formed by Two Cylindrical Surfaces, Yuri H. Avetisyan1, Armen H. Hakopian2, *Verevan* State Univ., Armenia, Stanford Univ., USA. We demonstrate undistorted two-dimensionally-confined THz pulses propagation in a 5-cm-long waveguide formed by two metallic cylindrical surfaces. A simple theoretical model explains experimental results. The possibility of using the waveguide in sensing application was tested.

**CfUQ3 • 11:00 a.m.**
Terahertz Microfluidic Sensor Based on a Parallel Plate Waveguide Resonant Cavity, Rajind Mendis, Victoria Ashley, Jingbo Liu, Daniel M. Mittleman, Rice Univ., USA. We fabricate a terahertz resonator suitable for microfluidic sensing by machining a groove into one plate of a parallel-plate-waveguide. We demonstrate a refractive-index sensitivity of 3.7 × 10^4 nm/refractive-index-unit, the highest ever reported in any frequency range.

**CfUQ4 • 11:15 a.m.**
Planar Terahertz Waveguides Based on Periodically Dimpled Metal Films, Gagan Kumar, Albert Cai, Apar Nathak, Univ. of Utah, USA. We demonstrate planar plasmonic THz waveguides based on dimpled metal films. The propagation properties of the guided modes depend upon the geometrical parameters of the dimples and can be broadly engineered.

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**Room C1&2**

**10:30 a.m.–12:15 p.m.**

**CfUR • Organic Optical Materials**
Yasujiro Enami; Hiroshima Univ., Japan, Presider

**CfUR1 • 10:30 a.m.**
Ultrafast Fiber Laser Mode-Locked by Graphene Based Saturable Absorber, Zhipei Sun, Tingying Han, Daniel Papa, Felicia Torrisi, Fengge Yang, Francesca Bonaccorso, Andrea C. Ferrari, Univ. of Cambridge, UK. A Graphene-based saturable absorber is fabricated using wet chemistry techniques. We use it to passively mode lock an Erbium doped fiber laser. 500fs pulses are produced at 1360nm with a 3.5nm spectral bandwidth.

**CfUR2 • 10:45 a.m.**
Disentangling Carbon Nanotubes for Broadband sub-100 fs Optical Switching, Winn Bae Che, Sun Young Cho, Jong Hyuk Yim, Soon Lee, Dong B Yoon, Kihung Kim, Fabian Rottenmaier, Andreas Schmidt, Valentin Petrov, Uwe Griesser, Guenter Steinmeyer3, A J唆大学, Republic of Korea, Max-Planck-Institut, Germany. Controlling bundling and curl of carbon nanotubes permits ultra-fast optical switching, which was demonstrated in a >500 nm near-infrared band by femtosecond mode-locking of three bulk lasers using one and the same saturable absorber.

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**Room C3&4**

**10:30 a.m.–12:15 p.m.**

**CfUs • Precision Spectroscopy**
Evgeni Sorokin; Technische Univ. Vienna, Austria, Presider

**CfUs1 • 10:30 a.m.**
Theory for Direct Frequency Comb Spectroscopy, Daniel Feldste, Carlos E. E. Lopez, Dept. de Fisica, Univ. Federal de Pernambuco, Brazil. We introduce a theory for the interaction of multi-level atoms with well-stabilized pulse trains, which is general enough to take into account arbitrarily-shaped frequency combs. It is applied to the excitation of rubidium-87 atoms.

**CfUs2 • 10:45 a.m.**
High-Resolution Spectroscopy Using Interleaved Optical Frequency Comb, Tatsutoshi Shindo, Kenichiro Fujii, Ken Kashiwagi, Tatsuya Kurokawa1, Nagasaki Univ. of Technology, Japan, Tokyo Univ. of Agriculture and Technology, Japan. We propose high-resolution spectroscopy based on the sweep of the interleaved optical frequency comb by an optical phase modulator. Fine spectrum of HCN gas has been successfully measured with 1MHz resolution over 4THz frequency range.

**CfUs3 • 11:00 a.m.**
Dual Frequency Comb Sampling of a Quasi-Thermal Incoherent Light Source, Fabrizio R. Giorgiotta, Ian Coddington, Esther Baumann, William C. Swann, Nathan R. Newbury, NIST, USA. Dual, coherent frequency combs are used to measure the spectrum of an incoherent, quasi-thermal source through Fourier spectroscopy. The source spectrum is acquired over 1THz bandwidth with an absolute frequency accuracy set by the comb.

**CfUs4 • 11:15 a.m.**
Trace Gas Detection with Frequency Comb Fourier Transform Spectroscopy, Rigeeta C. Raj Naik, Evgenii Narimanov, Alexandra Boltasseva, Vojtech Husak, Evgenii Narimanov, 4Purdue Univ., USA. We propose high-resolution spectroscopy based on the sweep of the interleaved optical frequency comb by an optical phase modulator. Fine spectrum of HCN gas has been successfully measured with 1MHz resolution over 4THz frequency range.

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**San Jose Ballroom IV**

**10:30 a.m.–12:15 p.m.**

**OTuD • QELS Symposium on Nanophotonics and Metamaterials I: Metamaterials**
Vladimir M. Shalaev; Purdue Univ., USA, Presider

**OTuD1 • 10:30 a.m.**
Invited
Infinite at Every Frequency: The Photonic Density of States in (Meta)materials with Hyperbolic Dispersion and Related Phenomena, Evgenii Narimanov, Zubin Jacob, Igor Smolyaninov, Purdue Univ., USA. We show that (meta)materials with hyperbolic dispersion exhibit a broad-bandwidth singularity in the photonic density of states, leading to dramatic changes in a variety of phenomena, from spontaneous emission to light propagation and scattering.
### Concurrent Sessions

Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.

### Room B2-B3

**J TuC • Applications of Laser Machining and Deposition**

- **J TuC1 • 10:30 a.m.** Applications in Precision Machining - Factors in n/a ps Choice, Stephen Lee, Colin Maethouse, Leonard Migliore, Coherent, Inc., USA. The pulse durations of industrial lasers have a significant effect on their processing characteristics. We will examine the effects of shortening laser pulses into the picosecond range, theoretically and then by examples of industrial processes.

- **J TuC2 • 11:00 a.m.** Ablation Dynamics in Burst-Train Femtosecond Laser Machining of High Aspect Ratio Holes in Glass, Peter R. Herman, Saeid Rezaei, Dagmar Esser, Abbas Hosseini, Jianzhao Li; 1Univ. of Toronto, Canada, 2Aachen Univ., Germany. Effect of 17 J/cm², we show critical pulse duration for Nitinol shape memory alloy near the fluence of 2.5 ps.

- **J TuC3 • 11:15 a.m.** Nitinol Machining Rate Dependence on Pulse Duration in the Ultrafast Laser Regime, Michael M. Mielke, David Gaudiosi; Raydiance Inc., USA. We quantify machining rate dependence on pulse duration for Nitinol shape memory alloy near the critical pulse duration for athermal ablation. At fluence of 17 J/cm², we show critical pulse duration is near 2.5 ps.

### San Jose Salon I & II

**San Jose Salon I & II**

- **J TuC • Nonlinear Effects in Photonic Crystal Fibers**
  - **J TuC1 • 10:30 a.m.** Strongly Enhanced Backward Second-Harmonic Generation with Slow Light in a Two-Dimensional Photonic Crystal, Rumea Ehrlich, Christoph Esser, Thomas Petrich, Yair S. Kivshar; Falk Lederer, Inst. of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller-Univ. Jena, Germany; Inst. of Applied Physics/Ulm Optics, Friedrich-Schiller-Univ Jena, Germany; Nonlinear Physics Ctr., Res. School of Physics and Engineering, Australian Natl. Univ., Australia. We obtain greatly enhanced conversion efficiencies of backward second-harmonic generation by exploiting small group velocities at phase match in a two-dimensional quadratically nonlinear photonic crystal. The efficiencies obtained from a modal approach are rigorously confirmed.

- **J TuC2 • 10:45 a.m.** Resonance Enhanced Large Third Order Nonlinear Optical Response in Slow Light InGaP Photonic Crystal Waveguides, Isabelle Canet, Guad Eificent, Sylvain Combrié, Pierre Colin, Alfredo De Rasel; Technion - Israel Inst. of Technology, Israel; Thales Res. and Technology Group, Univ. of Twente, Netherlands, 3Telecommunication Engineering Group, Univ. of Twente, Netherlands. We report a large third order nonlinear response in an InGaP photonic crystal waveguide. The nonlinearity is enhanced by a resonance effect due to the waveguide end facet reflectivities and the large group index.

- **J TuC3 • 11:00 a.m.** Highly Efficient, Broadband Cherenkov Radiation in Photonic Crystal Fibers, Li-Jin Chen, Guoqing Chang, Franz X. Kärtner; MIT, USA. The dependence of Cherenkov radiation on pump pulse parameters is investigated. Based on this effect a tunable, highly efficient (40%), broadband (>50 nm), green-orange light source resulted in efficient laser emission in an open cavity configuration.

### San Jose Salon III

**San Jose Salon III**

- **J TuU • Waveguides and Microlasers**
  - **J TuU1 • 10:30 a.m.** C-H, Gas Laser Inside Hollow-Core Photonic Crystal Fiber Based on Population Inversion, Andrew M. Jones, A. V. Vasileva-Olemech, Narmiri Ratanavis, Rajesh Kadel, Natalie V. Wheelier, Francois Couve, Jeffrey Renfud, Wolfgang Rudolph, Brian R. Washburn, Lotfian I. Corwin; Dept. of Physics, Kansas State Univ., USA, Dept. of Physics and Astronomy, Univ. of New Mexico, USA, Dept. for Photonics and Photonic Materials, Dept. of Physics, Univ. of Bath, UK. Lasering from population inversion is demonstrated from gas contained in a hollow-core kagome structured photonic crystal fiber. Laser pulses in the mid-IR (3.1–3.2 µm) were generated by optical pumping at -1.5 µm.

- **J TuU2 • 10:45 a.m.** Highly Efficient Yb:YAG Channel Waveguide Laser with 1.7 W Output Power Fabricated by fs-Laser Writing, Thomas Calmann, Alphonse de Serres, Isabelle Cestier, Gadi Eisenstein, Sylvain Combrié, Pierre Colin; 1Technion - Israel Inst. of Technology, Israel, 2Dept. of Physics, Kansas State Univ., USA, 3Thales Res. and Technology Group, Univ. of Twente, Netherlands. fs-Laser induced channel waveguides were written in crystalline Yb (7%):YAG with fs-laser pulses. Pumped by an OPS-laser at 969 nm laser oscillation with up to 1.76 W output power was demonstrated.

- **J TuU3 • 11:00 a.m.** High Gain KY(WO₄)₂:Er³⁺ Planar Waveguide Laser at the Zero-Phonon Line, Dmitri Gokas, Shumugam Aravum, Kerstin Wöhrsch, Markus Pollnau; Univ. of Twente, Netherlands. When pumping at a short wavelength of 392 nm, the high gain obtained at the 981-nm zero-phonon line of a KY(WO₄)₂:Er³⁺ planar waveguide resulted in efficient laser emission in an open cavity configuration.

- **J TuU4 • 11:15 a.m.** Low-Threshold, Single-Frequency Distributed-Feedback Waveguide Laser in Al₂O₃:Er³⁺ on Silicon, Edward H. Bernhard; Edward H. Bernhard; Henk A. G. M. van Wijgerden, Laura Agazzi, Md. Rezaul H. Khan; Univ. of Bath, UK. We report a single-frequency distributed-feedback laser at 1.55 µm with a threshold of 1.4 mW. The laser is fabricated on silicon substrates using a maskless direct wafer bonding process.
Room A1

CTuK • Ultrafast Sources—Continued

CTuK5 • 11:30 a.m. Generation of Sub 20 fs Deep-Ultraviolet Pulses Using Broadband Chirped-Pulse Four-Wave Mixing, Yutakuro Kida1,2, Jun Liu1, Takahiro Tanemoto1,2, Kazuhiro Kobayashi1,2,1, Dept. of Applied Physics and Chemistry and Inst. for Laser Science, Univ. of Electro-Communications, Japan, 1Inst. of Cooperative Res. Project, IE, Japan, 2Dept. of Electrophysics. Natl. Chiao Tung Univ., Taiwan, 1Inst. of Laser Engineering, Osaka Univ., Japan. Sub-20 fs deep-ultraviolet pulses were generated without a pulse compressor. Our approach allows one to compensate pulse broadening in air and glass appropriately and has a possibility of generating sub-7 fs pulses for ultraviolet spectroscopy.

CTuK6 • 11:45 a.m. Development of an 10-14 Ultra High Contrast CTuK7 • 12:00 p.m. 800 nm Dielectric Gratings for High Energy Large Area High Efficiency Broad Bandwidth Laser System Using High Energy XPW Filtering Scheme, Pierre-Marie J. Paul, Lorenzo Canova1, Amplitude Technologies, France, 1Lab d’Optique Appliquée, France. We have developed a 4 mJ, 60 nm bandwidth and 10-14 contrast Laser system. We used the most energetic 1mJ-XPW signal ever produced to seed a standard CPA Laser.

CTuK7 • 12:00 p.m. Large Area High Efficiency Broad Bandwidth 800 nm Dielectric Gratings for High Energy Laser Pulse Compression, Dale H. Martz1, Hoang T. Nguyen, Dinesh Patel1,2, Jerry A. Britten1,2, Dave Gao, Shikshik Naltsiannap, Chee Wei Wong, Columbia Univ., USA. We demonstrate a strong optical coupling in a high-quality-factor air slot mode-gap photonic crystal cavity with ultra-small mode volume, with a coupling length L=2.9µm. Optomechanical coupling lengths with different slot gaps and lengths are also compared.

CTuK8 • 12:00 p.m. Transverse and Longitudinal Optical Forces of Self-Alignment in Waveguides, Amit Mizrahi1, Katsuhiko Ieda, Fabio Bonomielli, Liang Feng, Vitaliy Lomonos, Yoshitaka Fujimaru, Univ. of California at San Diego, USA. We demonstrate novel transverse and longitudinal optical forces that facilitate self-alignment between two parts of a waveguide broken by an offset and a gap. We analyze two-dimensional configurations and extend the discussion to three-dimensional systems.

Room A2

Room A3

CTuL • Cavity Enhanced Optical Forces and Sensing—Continued

CTuL5 • 11:30 a.m. Sub-Wavelength Nano-Fluidics on Suspended Photonic Crystal Sensors, Min Huang1, Almeri Ali Yunke1, Trump Yao Chang1, Hantze Alling1, Boston Univ., USA, 2MIT, USA. We introduce a novel sensor scheme that combines nano-photonic and nano-fluidicics on a single platform using freestanding photonic crystals. The sensor with 350 nm RIU sensitivity can lead to enhanced analyte delivery to the sensor surface.

CTuM4 • 11:30 a.m. Gain Statistics of a Fiber Optical Parametric Amplifier with a Temporally Incoherent Pump, Boying Xu1, Stewart G. Murdoch1, Physics Dept., Univ. of Auckland, New Zealand. We present an experimental investigation into the statistics of the gain fluctuations of a fiber optical parametric amplifier pumped with a temporally-incoherent pump. These statistics are shown to be a strong function of signal detuning.

Room A4

Room A5

CTuM5 • 11:30 a.m. A Novel Method of Pump and Idler Signal Generation for Non-Degenerate FWM Based Phase Sensitive Amplification, Stilianos Sygelotou1, Rouwen Watanerseya1, Selwan Ibrahim1, Fatima Gunning1, Andrew Ellis1, Richard Phelan1, James O’Gorman1, John O’Carroll2, Brian Kelly1, Yanik1, Tsung-Yao Chang2, Hatice Altug1; 1Boston University, USA, 2MIT, USA. We report on dye fluorescence enhancement (10-fold) with high spatial confinement (100nm-deep, 1µm-wide) on a photonic crystal (PC) through resonant excitation of photonic modes. These features make the PC an excellent substrate for fluorescence microscopy.

CTuM6 • 11:45 a.m. Fluorescence Microscopy on a 2-D Photonic Crystal Transparent in the Visible, Alejandro Yacovitti1, Laura C. Estrada1, Oscar E. Martinez1,2, Maia Brunstein1, Luc Le Gratiet1, Sophie Bouchard1, Anne Tahhan1, Isabelle Sagon1,2, Ariel Leventon1; Lab de Photonic et de Nanostuctures (CNRS UPR 20), France, 1Quantum Electronics Lab, Argentina. We report on dye fluorescence enhancement (10-fold) with high spatial confinement (100nm-deep, 1µm-wide) on a photonic crystal (PC) through resonant excitation of photonic modes. These features make the PC an excellent substrate for fluorescence microscopy.
QTuC • Spatial and Temporal Solitons—Continued

QTuC5 • 11:30 a.m.
Solitons in Two-Dimensional Binary Superlattices, Matthias Heimrich, Yaroslav V. Kartashov, Laura R. Kimerer, Alexander Scrineti, Felix Dreisow, Robert Kief, Stefan Nolte, Andreas Tünnermann, Victor A. Vysloukh, Lluis Torner; Friedrich-Schiller-Univ. Jena, Germany, Uppsala, Sweden, Max Planck Inst. of Quantum Optics, Germany. We report on soliton formation in laser-written two-dimensional binary waveguide lattices. Even for small index contrasts between the sublattices, soliton intensity profiles and power thresholds strongly depend on whether “deep” or “shallow” channels are excited.

QTuC6 • 11:45 a.m.
Interacting Solitons in a High Index Glass, Alessia Pasquazi, Elena D’Asaro, Shirin Heidari-Bateni, Salvatore Stivala, Gaetano Assanto; Univ. du Québec, Canada, Univ. Roma Tre, Italy, Univ. of Palermo, Italy. We investigate the interaction of two coherent 2-D+1 solitary beams in a high index glass.

QTuC7 • 12:00 p.m.
Experimental Investigation of Slow Oscillations of Dispersion-Managed Solitons, Haldor Hartvig, Feder Mitschke; Univ. Rostock, Germany. Slow oscillations of dispersion-managed solitons have been predicted in theory. We confirm their existence in the experiment by measuring spectral width variations. Results are compared to numerical simulations; detailed agreement is achieved.

CTuO • Photonic Crystal/Novel Waveguide Lasers—Continued

CTuO4 • 11:30 a.m.
Flexible Photonic Crystal Defect Lasers on a Polydimethylsiloxane Polymer Substrate, Kung Shu Hsu, Yi-Chun Yang, Yao-Ying Tsai, Min-Hsiung Shie, Meng-Chyi Wu; Dept. of Photonics, Natl. Chiao-Tung Univ., Taiwan, R.O.C, Taiwan. We demonstrate a flexible photonic crystal defect laser on a polydimethylsiloxane (PDMS) polymer substrate. The curvature dependences of lasing power and threshold were also characterized by bending the photonic crystal cavity at different bending curvatures.

CTuO5 • 11:45 a.m.
Anti-Guided Bragg Reflection Waveguide Diode Lasers, Bhavin J. Bijlani, Amr S. Helmy; Univ. of Toronto, Canada. A novel edge-emitting Bragg reflection waveguide laser with a low index core is demonstrated. Single transverse mode operation is observed with typical thresholds below 250 A/cm² and propagation losses of 11.4 cm⁻¹.

CTuO6 • 12:00 p.m.
Electrically Pumped Supermode Si/InGaAsP Hybrid Lasers, Xiankai Sun, Michael J. Shearn, Avi Zadok, Marina S. Leite, Scott T. Steger, Harry A. Atwater, Axel Scherer, Amnon Yariv; Caltech, USA, Bar-Ilan Univ., Israel. Supermode Si/InGaAsP hybrid lasers with a varying-width Si waveguide have been fabricated and shown to be superior to these lasers with a uniform-width Si waveguide. Edge emission images demonstrate mode evolution.

CTuP • CLEO Symposium on Novel Optical Fibers: Biochemical and Biomedical Applications—Continued

CTuP4 • 11:30 a.m.
Holographically Encoded Microbeads: A Flexible Multiplex Platform for Bioassay Applications, J. A. Moon, M. S. Bowen, J. F. Pinto; Illumina, Inc., USA. Glass filaments containing digital holographic codes are ideal substrates for multiplexed bioassays. We describe a multiplex assay platform that provides for many hundreds of unique probes in a single well of a standard 96-well microplate.

10:30 a.m.–12:30 p.m. Market Focus: Photonics for Energy I, San Jose McEnery Convention Center, Exhibit Hall 2

12:15 p.m.–1:00 p.m. Lunch Break (concessions available on exhibit floor)
CtuQ6 • THz Waveguides—Continued

CtuQ6 • 11:30 a.m.
Dielectric-Lined Metallic Waveguides: Mode Structure and Dispersion at THz Frequencies, Oleg Mitrofanov1, James A. Harrington2; Univ. College London, UK, 1Rueters Univ., USA. We demonstrate low-dispersion and low-loss THz pulse propagation in dielectric-lined metallic waveguide. Waveguide modes are visualized using THz near-field imaging. Experimental dispersion characteristics and analytical approximations for the propagation constants will be presented.

CtuQ6 • 11:45 a.m.
Terahertz Resonance Splitting via Mutual Coupling between Parallel-Plate Waveguide Cavities, Victoria Austin, Rajind Mendis, Daniel Mittleman; Rice Univ., USA. The inclusion of multiple resonant cavities in a terahertz waveguide, a parallel-plate waveguide induces splitting of the fundamental resonance due to coupling between the cavities. The resulting features have a higher Q-value than the original resonance.

CtuR5 • Organic Optical Materials—Continued

CtuR6 • 11:30 a.m.
Effective Generation of Triplet States and Single Oxygen by Sulfur-Containing Squaraines: Experimental and Theoretical Study, Davinder Pande1, Andy O. Gowan2, Scott Webster; Hans-Georg Hau2, Lazaru Pudil2, Vladimir V. Kandus2, Yury L. Slominsky1, Oleksandr-O. Vynychuk1, Alexey D. Kachkovski1, Artem E. Maranov1, Olga V. Pechenoka1, David J. Hagan1, Eric W. Van Stryland1; CSEOL, College of Optics and Photonics, Univ. of Central Florida, USA, 1Inst. of Organic Chemistry, Natl. Acad. of Sciences, Ukraine, 2NanoScience Technology Ctr., Univ. of Central Florida, USA, 1Inst. of Physics, Natl. Acad. of Sciences, Ukraine. Efficiency of singlet oxygen generation is investigated for a series of new sulfur-containing squaraines molecules. Experimental results, in agreement with quantum calculations, show both large triplet quantum yield and quantum yield of singlet oxygen generation.

CtuR6 • 11:45 a.m.
New Organic Nonlinear Optical Crystal BDAS-TP for Terahertz Applications, Masashi Yoshimura1, Takashi Matsukada1, Yoshikazu Take01, Kyo Takey1, Yoshinori Takahashi1, Hirohito Umezo1, Shuya Okada1, Masayoshi Tomo1, Yusei Kitaoka1, Yuusuke Mor1, Osamu Oku1, Japan, 1FNICT, Japan, 1Yamagata Univ., Japan, 2Bul 4-dimethylamino-N-methyl-4-stilbazolium] tetraphenylborate (BDAS-TP) was newly designed as an organic nonlinear optical material. Broadband terahertz pulses have been generated in the single crystal by optical rectification of 78 fs pulses from Er-doped fiber laser.

CtuS5 • 11:30 a.m.
Large Core Acetylene-Filled Photonic Microspheres Made by Tapering the Hollow-Core Fiber, Natalie V. Wheeler, Michael D. W. Green, Philip S. Light, Francois Coupez, Timothy A. Birks, Erich Benabid; Univ. of Bath, UK. We fabricated low insertion loss and large core (40 - 70 μm) kagomé lattice acetylene-filled photonic microspheres by tapering the large outer diameter kagomé fibers and splicing their reduced ends to a single mode fiber.

CtuS6 • 11:45 a.m.
Precision Spectroscopy of Atomic Mercury in the Deep Ultraviolet Based on Fourth-Harmonic Generation from an Optically Pumped External-Cavity Semiconductor Laser, Justin Paul, Yuhei Kanada, Taai-Lian Wang, Christian Lytle, Jerome V. Moloney, Jason Jones; College of Optics and Photonics, Univ. of Arizona, USA. We demonstrate tunable single-frequency operation and precision spectroscopy of the 6S1/2,1S0 transition (254 nm) utilizing fourth-harmonic generation of an optically pumped external-cavity semiconductor laser. We furthermore characterize the intrinsically narrow linewidth of the source.

CtuS7 • 12:00 p.m.
Auto-Stabilization of Ring Lasers Based on Whispering Gallery Mode Resonators, Benjamin Sprunger1, Harald G. L. Schwefel2, L. J. Wang; Max-Planck-Institut fur die Physik, Gemen. We present a stabilized ring laser using a whispering gallery mode resonator. Experiments using micromasers with quality (Q) factors of 109 show lasing linewidths down to 170 kHz, limited by the resolution of the measurement.

QtuD4 • 11:30 a.m.
Fano Resonances in High-Tc Superconducting Metamaterials, Vasu A. Fedotov1, Jinhui Shi1, Erkang Sun1, Anagnostis Tsiatmas1, Peter de Groot1, Jiping Chen1, Nikolay Zheludev1; Univ. of Southampton, UK, 1Rutherford Appleton Lab, UK. We demonstrate a millimeter-wave range metamaterial fabricated from cuprate superconductor. Two complementary metamaterial structures have been studied, which exhibit Fano resonances emerging from the collective excitation of interacting magnetic and electric dipole modes.

QtuD5 • 11:45 a.m.
Carbon Nanotubes in a Photonic Metamaterial: Giant Ultrafast Nonlinearity through Plasmon-Exciton Coupling, Andrey E. Nikolaenko1, Francesco D’Angelo1, Stuart A. Boden1, Nikitas Papasimakis1, Peter Ashburn1, Enrico Di Fabrizio1, Nikolay I. Zheludev, 1Optoelectronics Res. Ctr., Univ. of Southampton, UK, 1Institut de Technologie and and the Univ. of Magna Graecia, Italy, 1School of Electronics and Computer Science, Univ. of Southampton, UK. We demonstrate that a combination of carbon nanotubes with metamaterial offers a new paradigm for the development of a media with exceptionally strong ultrafast near-infrared nonlinear optical response which can be controlled by metamaterial design.

QtuD6 • 12:00 p.m.
Extreme Tuning of Microphotonic Structures Using Optical Forces, Gustavo S. Wiederhoecker, Sankarshan Shankaran, Sunwoo Lee, Michael Lipson, Cornell Univ., USA. We show evidence of extreme tuning of micro-photonic resonances (31.4 nm) using optical gradient forces. We estimate the static mechanical displacements to be as large as 60 nm using mW level optical powers.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Joint QELS 05. Nonlinear Optics and Novel Phenomena

Paper Withdrawn

Direct Measurement of Electron Loss Rate in Air, Arthur Dogaru, Mikhail N. Shevchenko, Richard B. Miles, Princeton Univ., USA. We present direct local measurements of electron attachment and recombination rates in atmospheric air. Using a microwave scattering based resonantly enhanced multi-photon ionization scheme we monitor the electron density dynamics with nanosecond resolution.

Cascaded Third Harmonic Generation in Random Media, Wenj Wang1, Vito Rappe1, Krzysztof Kalinowski, Dragomir N. Neshev1, Matthias Heinrich, Robert Kell, Stefan Nolte1, Andreas Tünnermann1, Ljungilation1, Physics Dept. and Solid State Inst., Technion-Israel Inst. of Technology, Israel, Inst. of Applied Physics, Friedrich-Schiller-Univ., Germany, Dept. of Optics and Inst. of Nanotechnology and Photonics of the Consiglio Nazionale delle Ricerche (CNR), Politecnico di Milano, Italy. We report on the first experimental realization of topological crystals, solely formed by a geometric potential of an undulated slab waveguide. Transport mechanisms like Bloch oscillations and Zener tunneling are demonstrated.

Controlling Cascade Third-Order and Fifth-Order Nonlinear Optical Processes via Atomic Coherence, Huahong Zheng, Jie Yang, Min Xin, Univ. of Arkansas, USA. We experimentally investigate the effects of cascade third-order and fifth-order nonlinear optical processes in a four-level atomic system. The relative strengths of these high-order nonlinear optical processes can be manipulated by controlling the atomic coherence.

Photonic Topological Crystals: Transport, Carvature, and Geometric Potential, Alexander Stamenov1, Felix Dressel1, Matthias Heinrich, Robert Kell, Stefan Nolte1, Andreas Tünnermann1, Ljungilation1, Physics Dept. and Solid State Inst., Technion-Israel Inst. of Technology, Israel, Inst. of Applied Physics, Friedrich-Schiller-Univ., Germany, Dept. of Optics and Inst. of Nanotechnology and Photonics of the Consiglio Nazionale delle Ricerche (CNR), Politecnico di Milano, Italy. We report on the first experimental realization of topological crystals, solely formed by a geometric potential of an undulated slab waveguide. Transport mechanisms like Bloch oscillations and Zener tunneling are demonstrated.

Bistability and Nonreciprocity in Nonlinear Disordered Media, Ilya V. Shadrivov1, Konstantin V. Vlaskin1, Yuri P. Bliokh1, Valentine Freilikher1, Yuri S. Kivshar1, Australian Natl. Univ., Australia, ‘Natl. Univ. of Ireland, Ireland, ‘Technion-Israel Inst. of Technology, Israel, ‘Bar-Ilan Univ., Israel. We study wave transmission through nonlinear random medium and predict novel effect resulting from an interplay of nonlinearity and disorder. We reveal that nonlinearity leads to bistable and nonreciprocal transmission properties of the localized modes.

Nonlinear Transmission, Scattering and Optical Limiting Studies of Graphene Dispersions, Jun Wang, Atsushi Nagata, Tomoyuki Sato, Tohoku Univ., Japan. We present the controllable band-gap structure and non-linear localized states in light of two-dimensional photonic superlattices. Bright gap solitons and vortex solitons residing in an additional mini-gap due to the extra periodicity are presented.

Self-Organization of Second Order NLO Activity in Chromophore-Doped (cyano phenylene sulfide) Polymers, Atsushi Sugasawa, Masahito Masumoto, Yuki Aihara, Nobuyuki Mase, Shigeru Tanaka, Shizuoka Univ., Japan. We report second order NLO activity in chromophore-doped polymer (cyano phenylene sulfide) transparent ferroelectric polymer indium-tin oxide thin film deposition procedure. Noncentrosymmetric structures were self-organized just by sandwiching pair of electrodes with different surface energies.

Enhanced Coherence of Weakly Coupled Lasers due to Amplitude Nonlinear Dynamics., Stefa S. Kivshar1; 1Australian Natl. Univ., Australia, 2Natl. Univ. of Ireland, Ireland, 3Technion-Israel Inst. of Technology, Israel, 4Bar-Ilan Univ., Israel. We present direct measurements of coherence by nearly an order of magnitude.

Slow Light Birefringence in Liquid Crystal Light Valves, Stefania Residori, Umberto Borlozzi, Jean-Pierre Huguenin, 1INL, Univ. de Nice-Sophia Antipolis, CNRS, France, ‘Thales Res. and Technology, France. By performing two-beam coupling experiments in a liquid crystal light valve, we show that when slow-light occurs in anisotropic media a large difference of the group index result for orthogonal polarization states of the input pulse.

Controlling Cascade Third-Order and Fifth-Order Nonlinear Optical Processes via Atomic Coherence, Huahong Zheng, Jie Yang, Min Xin, Univ. of Arkansas, USA. We experimentally investigate the effects of cascade third-order and fifth-order nonlinear optical processes in a four-level atomic system. The relative strengths of these high-order nonlinear optical processes can be manipulated by controlling the atomic coherence.

Photonics and Nonlinear Optics: Fundamentals and Applications

Surface Texturing of Dental Implant Surfaces with an Ultrafast Fiber Laser, Bülent Öktem1, F. Ömer Ilday1, 1Bilkent Univ., Turkey, ‘Ankara Univ., Turkey, ‘FiberLAST, Ltd., Turkey. Controlled modification of implant surfaces using femtosecond, picosecond and nanosecond pulses offer superior control over the surface texture. Cell attachment to laser textured surfaces is discussed.

Fabrication of Gold-Platinum Nanoparticles by Intense, Femtosecond Laser Irradiation of Aqueous Solution, Takahiro Nakamura, Yuliati Herbani, Shamsiuddin Sattar, Tohoku Univ., Japan. Gold-platinum alloy nanoparticles were fabricated by high-intensity femtosecond laser irradiation of mixed aqueous solutions of auric and platinum ions with different mixing ratios.

Self-Organized Microstructuring of Amorphous Silicon for Microelectronics, Mahadi Halim, Amin Abdolvand, Yongchang Fan, Saydulla Perinov, Charles Maan, Eined Rafiullin, Mervyn Rose, Univ. of Dundee, UK. We present experimental and theoretical work on excimer laser microstructuring of hydrogenated amorphous silicon (a-Si:H) films on molybdenum coated glass substrates, in the form of sharp and conical poly-Si spikes, for electron field emission applications.


Generation of Spatiotemporal Bessel-Gauss Beams, Michail Dallaire, Caroline Fortin, Michel Pichot, Nathalie McCarthy, C. d’Orqueville, Photonique et Laser, Univ. Laval, Canada. Spatiotemporal Bessel-Gauss beams have been generated with a zero-dispersion pulse shaper that uses a reflective mask of annular shape. Such a setup acts as a static phase axicon.

Characterization of Pump-Induced Refractive Index Changes Observed in Nd3+ and Yb3+ Doped Laser Materials, Rémi Soulard1, R. Moncorgé1, J. L. Doualan 1, O. L. Antipov 1, 2, O. N. Eremeyev1, 2, A. Zinoviev1, 2, E. I. Ivanitskii 1, A. V. Suhbahadur1, 1Univ. de Geen, France, ‘Thales Res. and Technology, France, ‘Russian Acad. of Sciences, Russia, ‘Russian Federation, ‘Natl. Acad. of Sciences of Belarus, Belarus. The refractive index changes which can be induced in pumped Nd3+ and Yb3+ doped laser materials have been measured using two pump-probe technique. Transient signal analysis allows to determine electronic and thermal contributions.

Influence of Surfactant on Shape and Oxidation of Copper Nanoparticles, Ram Gopal, Raj Kumar Shukar, Sadabah Chandika Singh, Univ. of Allahabad, India. Influence of surfactant on shape and oxidation of copper nanoparticles synthesized by pulsed laser ablation in aqueous medium has been studied.

Laser Fabrication of 1-D Micro-Optical Components by Localized VapORIZATION and Bumping, Kristian L. Wålsäter, Howard J. Baker, Dennis R. Hall, Heriot-Watt Univ., UK. A new approach for fabrication of sub-millimetre width, cylindrical mirrors in fused silica by localized CO2 vapourization and bumping is presented. Formation of reversed bumps and their removal by annealing is investigated here.

Femtosecond Laser Ablation Rates of Dielectric Materials: Experiments and Modeling, Ljepo Bykovic-Njilic1, Bjanka H. Christovnenkis1, Dang Q. S. Le, Mehrnaz N. Christovnenkis, Peter Bunning1, ‘Aarhus Univ., Denmark, ‘Danish Technological Inst., Denmark. Short-pulse laser ablation of dielectrics is modeled using multiple-rate equations for the electronic excitation combined with optical propagation. The model is compared to single-shot experiments on well-defined single-crystal samples.

Cleo 15. LEDs, Photovoltaics and Energy-Efficient (“Green”) Photonics

Characterization of a Planar Green Light-Emitting Diode Using Nanodot Lateral Overgrowth, Shih-Chun Lin, Shih-Pang Chang, Mao-Chang Lu, Hao-Chung Kuo, Shing-Chung Wang, Natl. Chiao Tung Univ., Taiwan. We have demonstrated nanodot lateral overgrowth to reduce dislocation density in a planar GaN. Subsequently, we grow green a plane-light-emitting diodes using nanodot lateral overgrowth. Output power of 0.5 mW was measured at 20 mA.
Taiwan, Industrial Technology Res. Inst., Taiwan. The guided resonance mode affected the different hole shapes of photonic crystals in GaN ultrathin film transferred-light-emitting diodes. The ellipse-hole PHC extracted a few modes than the regular PHC, due to the lattice symmetry break.

JTuD30

Hole Shape Effect of Photonic Crystals on the Light Emitting Diodes' Resonance Modes in GaN-Based Ultra-Thin Film-Transferred Light-Emitting Diodes, Chun-Feng Lai1, C. H. Chao2, H. C. Chun-Feng Lai1,2; 1Penn State Univ., USA, 2Sunchon Natl. Univ., Republic of Korea. We fabricated an InGaN nanowire LED structure coupled with colloidal quantum-dot (QD) phosphors. Time-resolved photoluminescence measurements for nanorod structures with and without QD coating were performed to study the direct MQW-to-QD non-radiative energy transfer.

JTuD31

Internal Quantum Efficiency Measurement in InGaN/GaN UV LEDs with Patterned Sapphire Substrate by Photoelectromissibility and Electroluminescence Method, Chao-Hsun Chao1, Chih-Chien Kuo2, C. H. Chao1, Hongjun Wang1, Da Chen 1, Chi-lun Allan Fan Zhang1, Chunfeng Zhang1, Jian Huan-Chiu1, Xiaomin Jin1, Chang Xiong2, Xingxing Fu2, Xiangning Kang2, Guoyi Zhang2, Bei Zhang3, Califomia Polytechnic State Univ., USA, Peking Univ., China. A 3-fold symmetric photonic-crystal grating is simulated using improved FDTD-model. Transmission gratings are optimized. Then, the best cases are simulated in GaN-LED models. The maximum extraction efficiency improvement is 4X greater compared to conventional LEDs.

JTuD32

GaAs-Nanowire/PEDOT:PSS Hybrid Solar Cells, Hsin-Jie Chao, Shu-Chia Shiu, Ching-Fuh Lin, Natl. Taiwan Univ., Taiwan. We investigated the effect of different geometries of metal nanostructures sit above or below the active material. Further enhancement of the emission efficiency of a light-emitting diode, Kun-Ching Shen, Chang-Yen Chen, Yen-Cheng Lu, Chie-Hao Liao, Chih-Yen Chen, Chih-Hsin, C. C. Yang. Natl. Taiwan Univ., Taiwan. Further enhancement of the efficiency of an InGaN/GaN quantum well (QW) light-emitting diode (LED) through QW coupling with surface plasmonics generated on Ag nano-gratings by inserting a SiO$_2$ layer between semiconductor and metal is demonstrated.

JTuD33

Enhanced Surface Plasma Coupling Effect with a Metal/SiO$_2$/GaAs Structure for Further Improving the Emission Efficiency of a Light-Emitting Diode, Justin White, Mark Brongersma; Stanford Univ./SLAC National Accelerator Laboratory, Stanford, CA, USA. A combined computational-experimental study optimizing plasmon-enhanced absorption in thin film solar cells presented. We investigate the effect of different geometries where 2-dimensional periodic-apertured arrays of metal nanostructures sit above or below the active material.

JTuD34

Hollow Core Fiber with an Octave Spanning Bandgap, Francesco Poletti, Optoelectronics Res. Ctr., Univ. of Southampton, UK. We demonstrate that amongst all known lattices, a triangular arrangement of interconnected resonators generates the widest possible out-of-plane bandgap. A photonic bandgap fiber with an octave spanning transmission range is presented for the first time.

JTuD35

In Situ Solution Doping Technique for Novel Geometry Rare Earth Doped Fiber Fabrication, Andrew S. Webb, Alexander I. Belyanin, Robert F. Standish, Depuis Lio, Shafi-ul Alam, Iyemen K. Salih, Optoelectronics Res. Ctr., Univ. of Southampton, UK. We report on the fabrication and characterization of an YDFP, with a particular geometry fabricated using an in-situ solution-doping process. The fiber has a uniform-stress inner-cladding and exhibits good efficiency.

JTuD36

High Power Fiber Amplifiers for Advanced Virgo, Caroline Gréverie1, Alain Brillet2, Feliksik2; 1Observatoire de la Côte d’Azur, France, 2Ctr. for Quantum-Engineering and Space-Time Res. - QUEST, Germany. We report on the passively mode locked ordinary diode fiber laser emitting pulses with a pulse energy of 11 nJ. The repetition rate of the oscillator was 2.09 MHz. The pulses could be dechirped to 1 ps.

JTuD37

Low Repetition Rate High-Energy Fiber Oscillator, Dirk Mortag1, Christian Hapke1, Dieter Wied1,2, Uwe Margner1,2, Dietmar Kracht1,2; 1Forschungszentrum Jülich, Germany, 2Center for Quantum Engineering and Space-Time Res. - QUEST, Germany. We report on a passively mode-locked ordinary diode fiber laser emitting pulses with a pulse energy of 11 nJ. The repetition rate of the oscillator was 2.09 MHz. The pulses could be dechirped to 1 ps.

JTuD38

24 nm Wavelength Tunable High Duty-Cycle, Self-Starting Figure-Eight Fiber Laser, Soon-Sik Min, Simon Fleming; Univ. of Sydney, Australia. The operation of a 24 nm wavelength tunable self-starting passively harmonic modelocked, figure-eight laser is experimentally demonstrated. Stable pulses with near half-duty cycle are produced at repetition rates of up to 2.725 GHz at 1550nm wavelength.

JTuD39

Ultra-Short Cavity Distributed Bragg Reflector Er-Doped Fiber Laser for Temperature-Insensitive Bending Measurement, Weihong Liu1,2,3, Yuan Gu1,2,5, Hanggan Wang1, Da Chen1, Chi-Ian Allan Wong1,2,3, Hua-Yau Tame1,2,3, Chao Lia1, Sailing He1,2,3, Hong Kang1, Polytechnic Univ., China, Zhejiang Sci-Tech Univ., China. We introduce a bending sensor by measuring the beat frequency shift of a DFB fiber laser. The polarization beat frequency of the DBR laser gives high sensitivity to the fiber bending while immune to temperature change.

JTuD40

Enhancement of Transmission by Optimization of Crystal Structure of Silicon-Core Optical Fiber, Vladimir V. Velmukh, Nikolay V. Komov1, Vasily V. Kholkov1, Elena B. Kryukova1, Liudmila D. Ishakova1, Sergey V. Lurichev1, Victor G. Plotnichenko1, Sergey L. Semyonov1, Evgeniy M. Dronov1; Fiber Optics Res. Ctr., Russian Academy of Sciences, Russian Federation, ‘General Physics Inst., Russian Academy of Sciences, Russian Federation, Silicon-core optical fibers were fabricated by the ‘red-in-tube’ method. Optical losses were reduced to the level of 11-12 dB/cm in a wavelength range of 1.3-6.7 μm owing to a post-drawing treatment similar to zone melting.

JTuD41

Stable and Wavelength-Tunable High-Speed Short Pulse Generation from a Rational Harmonic Mode-Locked Short-Cavity Fiber Laser Using a Bismuth-Based Erbium-Doped Fiber and a Bismuth-Based Nonlinear Fiber, Yutaka Fukuuchi, Jiro Miura; Tokyo Univ. of Science, Japan. We demonstrate a rational harmonic modelocked short-cavity laser employing a bismuth-oxide-based erbium-doped fiber and a bismuth-oxide-based highly nonlinear fiber. Stable short pulses up to 40GHz are obtained over the wavelength tuning range covering the C-band.
JTuD04
PhE Quantum Dots Liquid-Core Fiber, Ali Hrebi, Frédéric Girévin, Jean-Louis Auguste, Quang Van Do, Jean-Marie Rondot, Univ. de Limoges, France; Nanotube Polyimide, USA. A liquid-core fiber has been experimentally investigated by inserting PhE/Seoharian solution media in the hollow-core of a capillary waveguide. Upon pumping by a 532 nm CW laser, a good amplified stimulated emission in 1290nm band was obtained.

JTuD04
Crossing of Scalar Dissipative Solitons along Different Polarization Axes in a Highly Birefringent Fiber Laser with SESAM, Laming Zhao, Dingyang Wang, Wu Xiaot, Han Zhang, Hua You Tan1; School of Electroaet and Electric Engineering, Nanyang Technological University, Singapore; Dept. of Electrical Engineering, Hong Kong Polytechnic Univ., Hang Ham, Hong Kong, China. Existence of scalar dissipative solitons along the two orthogonally polarized directions of a fiber laser is observed. Due to the large cavity birefringence, the dissipative solitons along different polarization axes have different group velocities.

JTuD04
Design Principle for Low Bending Losses in All-Solid Photonic Bandgap Fibers, Tatashi Murao, Kinue Masuda, Kiyao Nagan, Masanori Nakamura, National Institute of Science and Technology, Hokkaido Univ., Japan. The structural dependence of factors which mainly affect a bending loss property is theoretically investigated in all-solid photonic bandgap fibers. A design principle for realizing a low bending loss is successfully figure out.

JTuD04
Timing Jitter Characteristics of Ultrashort Optical Pulse Generator Using Mach-Zehnder-Modulator-Based Flat Comb Generator, Isao Morohashi, Takahide Sakamato1, Hideyuki Morohashi, NTT, Japan, Asymmetric Kaikoku Univ., Japan. We report on timing jitter characteristics of ultrafast pulse trains generated by a Mach-Zehnder modulator-based flat comb generator. By phase noise measurements, the rms timing jitter of our pulse generator was estimated to be 70 fs.

JTuD04
Generation of 63-nJ Pulses from a Fiber Oscillator Mode Locked by Nanotube, Daniel Pope, Zhiping Sun, Felix Terris, Tanpeng Huan, Fengjie Wang, Andrea C. Ferraro, Univ. of Cambridge, UK. A fiber mode-locked oscillator with cavity length of ~150um using nanotubes, achieving 1.5ps pulses with pulse energy up to 63nJ at 1314 kHz repetition rate.

JTuD04
Formation, Sprinkling, Trapping and Annihilation of Pulses in Passively Mode-Locked Fiber Lasers with Modulated Noise, Alon Schwartz, Raji Weil, Michael Katt, Alexander Bekker, Vladimir Smolyakovsky, Baruch Fischer, Technion - Israel Institute of Technology, Israel. Injection of modulated noise into mode-locked fiber lasers provides rich pulses formation and sprinkling effects with trapping and annihilation centers in the cavity. The lightning experiment demonstration is accompanied by statistical light mode dynamics analysis.

JTuD04
A Film Type Saturable Absorber with PH3T-Incorporated Single-Wall Carbon Nanotubes Coated on Polyamide and its Application to a Femtosecond Fiber Laser, Funmi Shohdad, Masatoku Nakazawa1, Junji Matza, Jyu Tsimakata1; Res. Inst. of Electronic Communication, Tohoku Univ., Japan. A film coating on the laser cavity was made using the polyethylene solutions, by which the saturable absorption effect can be observed in a wide range of the number of films. A 113-fs, 42-MHz pulse was successfully generated with two films.

JTuD04
Effective Area Scaling of the Multifilament Fiber Core, Guillaume Canat, Laurent Lombard, Rom Spittel, Sylviane Jechte, Pierre Bordon1, UNED, France; Dept. of Photonics, Germany. Multifilament fiber core (MFC) design enables low NA fiber using high index materials. We study the scaling of MFC effective area using an effective step-index model. MFC fibers mix step index and multilayer fibers properties.

JTuD04
All-Fiber All-Normal Dispersion Laser with an in-Fiber Ytterbium Laser, Nuno Brandão, João M. Barata1, Carlos J. Barata, E. R. G. Cabral1, Univ. of Aveiro, Portugal. We propose a use of a short MPM fiber section as birefringent medium to construct an all-fiber ytterbium laser with bandwidth adjustable through the MPM fiber length. An all-fiber normal-dispersion laser is demonstrated using standard components only.

JTuD04
Second and Third Harmonics Generation in Tellurite Microstructured Fibers, Guanlin Qin, Meifeng Liao, Chiting Xue, Xian Yan, Takanobu Suzuki, Yatakide Ohkishi, Toyota Technological Inst., Japan. We demonstrate the second and third harmonics generation in tellurite microstructured fibers pumped by a 1557 nm femtosecond fiber laser.

JTuD04
Gain Enhancement in Hybrid Fiber Raman/Parametric Amplifiers, S. H. Wang, P. K. A. Wai, Hong Kong Polytechnic Univ., Hong Kong. We propose a hybrid fiber Raman/parametric amplifier which can have significant gain enhancement over that of a Raman-assisted fiber optical parametric amplifier using the same length of fiber, Raman and parametric pump powers.

JTuD04
All-Fiber, Versatile Pico-second Time-Lens Light Source and Its Application to Cerenkov Radiation Generation in Higher Order Mode Fiber, Ke Wang, Jennifer H. Lee, Yatong Dai, Ji Cheng, Chris Xu, Cornell Univ., USA. We demonstrate an all-fiber, 2-ps, 1665-nm source using time-lens compression of a continuous-wave laser, with variable repetition rates, pulse sequence, and alternating pulse amplitude. We demonstrate Cerenkov radiation in a higher-order-mode fiber using the source.

JTuD04
Bismuth Oxide Based Ytterbium Doped Double Clad Fiber Laser, Seiki Okano, Asahi Glass Co., Ltd., Japan. Ytterbium-doped bismuth oxide-based double clad fiber was fabricated. The absorption of the fiber was 1430-1470nm. Fiber lasers were demonstrated with a resonator of a FGB and a splicing point with a high refractive index glass.

JTuD04
Supercontinuum Generation in Tapered Fibers Embedded in Silica Aerogel, Matthew D. Rollings1, Michael D. W. Gregory1, Linton Xiao1, Richard England1, Tim A. Baker2, William J. Wadsworth2; Dept. of Physics, Univ. of Bath, UK. We demonstrate spectral broadening in tapered optical fibers embedded in silica aerogel. The aerogel fiber all-normal dispersion fiber laser was demonstrated with a resonator of a FGB and a splicing point with a high refractive index glass.

JTuD04
Stable Photonic Crystal Fiber Sensor for Ultra-High Temperature Measurements, Vittoria Finazzi, Gianluca Cortes, Joel Villatoro1, Valerio Pruneri2; VICS s.r.l., Sicily, Spain. We have developed a stable photonic crystal fiber sensor for ultra-high temperature measurements (up to 1000°C). We show that the sensor head needs a long thermal annealing to achieve a stable functionality level.

JTuD04
Modes in Fiber Random Laser, Valentin Frei-Brickler1, Vicky Blohk1, Noemi Lázár1, Elena Chukina1, Eugenio Menes1; Bar-Ilan Univ., Israel; Institute of Israeli Inst. of Technology, Israel. We present the results of the experimental and theoretical studies of the random laser based on an Er/Gd co-doped single-mode fiber with randomly spaced Bragg gratings.

JTuD04
High-power Narrow-band Pulsed Timed-Doped ZBLAN Fiber Lasers, Junhua Xu, Lin Jun, Yulong Yang, Shanghao Zhang1, Optics and Fine Mechanics, Chinese Acad. of Sciences, China. Pulsed Timed-Doped ZBLAN fiber lasers operated at 1941 nm are demonstrated with average power of 120W and emission bandwidth of 0.8 nm. The pulsed width is about 50 ps at repetition rate of 50 kHz.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Nonlinear Beam Reflection by Negative Defects in Photonic Lattices, Xuanying Wang, Jianke Zhang, Zhongwei Tang, Zhenyu Ye, Alex Miller, Yi Hu, Cihan Liu, Peng Zhang, Diquang Chen; University of Electronic Science and Technology of China, China, "San Francisco State Univ., USA. We demonstrate that a nonlinear beam is reflected by a negative defect in photonic lattices if the incident angle is below a threshold. This phenomenon can be used to control beam propagation in photonic lattices.

CLEO 03. Semiconductor Lasers

Room-Temperature Operation of λ=3.7μm GaAs Quantum Cascade Laser Sources, Ming ling, Robert W. Adams, Jianmin Chen; Claire Gmachl, Linx Cheng; Shu-Sen Chai; Mikhail A. Belkin; Univ. of Texas at Austin, USA, "Princeton Univ., USA, "Univ. of Maryland, Baltimore County, USA. We report room-temperature operation of λ=3.7μm InGaAs/AlInAs/InP quantum cascade lasers based on frequency doubling with ~2mW/W conversion efficiencies. Similar devices based on 1% strain-compensated materials can operate at 3-3.7μm.

limitations to the Power Output and Efficiency of Mid-Infrared Quantum Cascade Lasers Imposed by transport, Yannick Dikmelik; Jacob B. Khurgin, Peter Q. Liu, Matthew D. Escarra, Min Jang, Robert W. Adams; 1University of Maryland, College Park, USA, 2Cork Institute of Technology, Ireland, 3University of Wisconsin-Madison, USA. We provide a density-matrix framework to evaluate the wallplug efficiency of mid-infrared quantum cascade lasers. We assess the limitations to maximum current and internal efficiency, imposed by injection coupling and current leak-injection, respectively.

Effect of Inhomogeneously Broadened Linewidth on the Phase Recovery of Quantum-Dot Semiconductor Optical Amplifiers, Jungho Kim, Christian Miehe, Dietrich Bomberger, Gadi Eisenstein; 1Department of Information Display, Kyung Hee Univ., Republic of Korea, 2Institut f黵 Festk黥emische Verfahrenstechnik, Technische Universitaet Berlin, Germany. We numerically demonstrate the phase recovery of quantum-dot (QD) semiconductor optical amplifiers becoming slower at larger inhomogeneous broadening linewidths, caused by the enhanced contribution from the down conversion recovery of the QD carrier reservoirs.

Two Color Phase Transients of 1.3 Micron InAs/ GaAs Quantum Dot SOAs, Mark T. Crowley, Tomasz Powsniewski, John Hoiboom; Alexander V. Ustinov, Guillaume Hayet, Ron P. Pringle; 1Tandem Ltd., Ireland, 2Cork Institute of Technology, Ireland, 3University of Strathclyde, UK. We report on an experimental and theoretical study of phase transients at 1.3 microns in an InAs/GaAs QD SOA in response to pump pulses tuned to either the dot ground or excited state.

Numerical Simulation of Dynamic Properties of High-Speed SOA with a Tunnel Injection Structure, Mikko Sarvim鋜ki, Yansuoka Higa, Shinya Matsuizaki, Tomoyuki Miyashita, Tokyo Institute of Technology, Japan. We provide numerically simulated dynamic properties of a SOA with a tunnel-injection structure considering tunneling current and biased potential. As a result, the tunneling injection SOA has potential of 40GHz or more high-speed operation.

Effect of Optical Feedback on 17-GHz Quantum Dash Based Mode Locked Lasers, Ricardo Rangel, Korrel Merghenian, Shahbazadeh Aminzadeh, Anthony Martinez, Francois Lelarge, Frederic Van Dyck, Guy Aubry, Abderrahmane Ramdane; 1CRUPS, France, 2Institut des Huiles V. L. Lab, joint lab of Roll Lab and Thales Res. and Technology, France. The effect of optical feedback is investigated for a quantum-dash-based passive mode-locked laser. We observe a drastic reduction of the radio frequency spectrum linewidth even after the onset of coherence collapse.

Tailoring of Chirp in Colliding Pulse Mode-Locked Diode Laser Generating 287 Hz Pulses after Amplification, Thoren Ulm, Florian Hirth, Johannes A. Dullweber, Photonics-Zentrum Kaiserslautern e.V., Germany. Collimation point and relative intensities of pulses in a passively mode-locked laser were optimized to generate a strong and almost linear chirp. We achieved 267μs pulses with 66W peak power using only quadratic phase compression.

Effect of Inhomogeneously Broadened Linewidth on the Phase Recovery of Quantum-Dot Semiconductor Optical Amplifiers, Jungho Kim, Christian Miehe, Dietrich Bomberger, Gadi Eisenstein; 1Department of Information Display, Kyung Hee Univ., Republic of Korea, 2Institut f黵 Festk黥emische Verfahrenstechnik, Technische Universitaet Berlin, Germany. We numerically demonstrate the phase recovery of quantum-dot (QD) semiconductor optical amplifiers becoming slower at larger inhomogeneous broadening linewidths, caused by the enhanced contribution from the down conversion recovery of the QD carrier reservoirs.

Self-Formation and Synchronization of Emitters in Broad Area Lasers in External Cavities, Mark Lichten, Mindung Kim, Andreas Kuzurak, Vesel Tronciu, Andreas Jeksch; Wissenschaftsinst. fur Angewandte Analysis und Synthesen, Germany, "University of Dortmund, Germany. Using a new model for dynamic simulation of broad area diode lasers with external cavities we find self formation of synchronized emitters for a broad area laser in a V-shaped external cavity.
JTuD108
High-Index-Contrast Single Output TearDrop Laser Fabricated Via Oxygen-Enhanced Non-Selective Oxidation, Christopher S. Seiber1, Hangying Su1, Douglas C. Hall1, Jianping Cao1, Tony Marette2, Alan R. Sugg1; 1Univ. of Notre Dame, USA, 2Yoga Wave Systems, Inc., USA. A high-index-contrast single-output tear-drop laser fabricated via oxygen-enhanced non-selective wet oxidation is demonstrated. The device offers a low (35 mA) threshold and high (138 mW) output power from a single, uncoated output facet.

JTuD107
Noise Contribution of Semiconductor Optical Amplifier Based Photonic Phase Shifters, Sean P. O’Duell, Evgeny Shumakher, Gadi Eisenstein; Technion, Israel. We present an analytical model to calculate the signal to noise ratio of a slow light based microwave phase shifter that uses semiconductor optical amplifiers. The model includes dynamic noise effects and is confirmed experimentally.

CLEO 02. Solid-State, Liquid and Gas Lasers

JTuD108
Laser Developments in Er3+:YAG Fiber-Shaped Crystalline Rod Lasers, Stefano Bigotta, Stefano Bigotta; 1, Yujie J. Ding1, Ioulia B. Zotova2; 1Lehigh Univ., USA, 2ArkLight, USA. Based on effec-
tive third-harmonic generation in two-section dual-periodic periodically-poled KTP crystal being

demonstrated. The device offers a low (55 mA) threshold and high (46.0 W with M2<1.1) was obtained. Effective A-O limited output pulses at 10W average power.

JTuD109
Synchronized Dual-Frequency Pulses from Q-Switched Compact Nd:YLF Laser Cavities, Pu Zhan1, Yuej J. Ding1, Ioulia B. Zotova2; 1Lehigh Univ., USA, 2ArkLight, USA. Based on a novel configuration of a dual-frequency laser system constructed from a Nd:YLF crystal, we have synchronized Q-switched laser pulses at 1047 nm and 1053 nm.

JTuD110
Over 300 mW Laser-Diode Pumped Green Laser Using Optical Contact Nd:YVO4/Periodically Poled MgO:LiNbO3, Crystal, Yong Lu, Qiongqiong Xu, Yi Gan, Changhai Xu; Dept. of Engineering Physics, McMaster Univ., Canada. An energetic nanosecond pulses difficult. We describe a cavity-dumped oscillator, regenerative amplifier system designed to deliver 100 mL, 20 mDiffrac-
tion limited output pulses at 10W average power.

JTuD111
Power Scaling of Coherent Blue Light Source Based on Frequency Tripling Inside Adhesive-Free Bond Composite Nd:YAG Laser Cavity, Pu Zhan1, Yuej J. Ding1, Ioulia B. Zotova2; 1Lehigh Univ., USA, 2ArkLight, USA. Based on effective third-harmonic generation in two-section dual-periodic periodically-poled KTP crystal being placed inside the cavity of adhesive-free bond composite Nd:YAG laser, we generated coherent blue light with output power reaching 200 mW.

JTuD112
Pulsed Intracavity Frequency-Doubled Cr:YAG, Raman Laser for Narrow-Line Sodium-Yellow Radiation, Chuan-Huan Li, Yi-Chih Huang; Inst. of Photonics Technologies, Dept. of Electrical Engineering, Natl. Yang Hua Univ., Taiwan. We report generation of 0.35 W sodium-yellow laser at 589 nm from a diode-end-pumped, actively Q-switched, intracavity frequency-doubled Raman laser with Cr:YAG, as the Raman gain medium in a Nd:YVO4, laser cavity.

JTuD113
Power Scaling of Directly Pumped Nd:GaVo4 Laser Using Growen together Composite Crystal, Xufeng Li, Xia Yi, Fei Chen, Ke Zhang, Ming Luo, Junhua Yu, Deying Chen; Natl. Lab of Tun-
able Laser Technology, Harbin Inst. of Technology, China. Power scaling of end-pumped Nd:GaVo4, laser was realized by directly pumping and grown- together crystal. A maximum CW output power of 46.0W with M2<1.1 was obtained. Effective A-O Q-switch operations were also reported.

JTuD114
Fiber Laser-Pumped Tsapphire Laser, Goutam K. Samanta, Chaitanya Kumar Siddhapalli, Kavita Devi, Majid Ebrahim-Zadeh; 1,2, Masaki Tsune-

JTuD115
Novel Concept of Timing Jitter Reduction of a Passively Q-Switched Microchip Lasers Using Self-Injection Seeding, Alexander Steinauert, Dirk Nodop, Jens Limpert, Andreas Tünnemann; 1Institut für Angewandte Photonik, Germany. We present an efficient and simple technique for reduction of timing jitter in passive Q-switched microchip-lasers using self-injection seeding using an optical-fiber as a delay-line and reduce the jitter by several orders of magnitude.

JTuD116
Diode-Pumped Passively Q-Switched Nd:YAG/ Cr3+:YAG Micro-Laser Controlled by Volume Bragg Gratings, Nicolas Paré1, Masaki Tsuneto2, Ivan Buchvarov1, Sofia Univ., Bulgaria, 2Dept. of Chemistry, Boston College., USA. Generation of a stable train of picosecond pulses with 3.8 mJ energy at 400 Hz repetition rate and 280 μs train envelope from a pulsed diode pumped Nd:YAG laser with electro-
trically-active volume Bragg gratings optical element as output coupler was realized. The influence of temperature on the laser pulse energy and wavelength of emission was investigated.

JTuD117
A High Energy, High Efficiency, Resonantly Pumped Nanosecond-Pulsed 1.6 μm Er:YAG Laser System, Stephen B. Moody, David L. Cunningham; Orca Photonic Systems, Inc., USA. Limited gain in Er:YAG makes generation of energetic nanosecond pulses difficult. We describe a cavity-dumped oscillator, regenerative amplifier system designed to deliver 100 mL, 20 mDiffrac-
tion limited output pulses at 10W average power.

Tuesday, May 18
toine Courjaud, for the E/Z polarization. Pulses as short as 49 fs at 1050 nm are achieved. A reflector tapered-diode laser is demonstrated. Delivering 1.8 mJ pulses at 100 Hz with a spectral pulse duration.

Kensuke Hirata, Yuzo Ishida, Sakae Kawato; Patrice Camy, Richard Moncorgé, Eric Mottay; Takama, Masahiro Inoue, Tatsuya Yamaguchi, Paschke, Götz Erbert, Valentin Petrov, Akira Yoshida, Andreas Schmidt, Huaijin Zhang; Sub-50 fs Diode-Pumped Yb:YCOB Laser, France, Univ. de Caen, France.

Broadband Regenerative Amplification in the Femtosecond Regime: Challenges and Solutions, Sandrine Ricard, Martin Delaigue, Sandrine Ansel, Brussels, Belgium. 


In-Plane MEMS Tunable Glasses-Tournois Interferometers, Raphael St-Gelais, Thomas Kerren, Alexandre Poulin, Yves-Alain Peter; Ecole Polytechnique de Montréal, Canada. We present MEMS tunable Glasses-Tournois interferometers based on deeply etched Bragg reflectors. The bandwidth of fabricated devices allows operation over almost the whole C and L bands. Applications such as tunable dispersion compensation are expected.

Optimizing Pump Partial Coherence for Efficient Modulation Instability and Supercontinuum Generation, J. C. Travers; Femtosecond Optics Group, Physics Dept., Imperial College London, UK. We consider the effect of variable pump source partial coherence on the gain of modulation instability and the subsequent efficiency of soliton formation and supercontinuum generation. Optimal regimes for continuous-wave supercontinuum generation are discussed.

Innovative Tone-Interferometric High Contrast Grating Reflector, Vadim Karazhinsky, Christopher Chua, Connie J. Chang-Hasnain; Dept. of Electrical Engineering and Computer Science, Univ. of California at Berkeley, USA. We present a new type of subwavelength grating, which provides ultraflat reflectivity when embedded in a high refractive index medium. It is therefore an ideal candidate to replace the bulk bottom DBR reflectors in VCSELs.

Novel Inverse-Tone High Contrast Grating Reflector, Valerie Codemard, Debashri Ghosh, Mrinmay Pal, Kang Kang, Anishuro Bhattacharya, Jessica Mondia, Fiorenzo G. Omenetto, Wuzhou Song, Jae-Woo Choi; Ecole Polytechnique Fédérale de Lausanne, Switzerland. Novel functionalities have been developed through the fusion of optics and microfluidics. We categorize the different possible tuning mechanisms in optofluidics and describe the recent examples in each category.

Picosecond Fiber MOPA Pumped Supercontinuum Source with 39 W Output Power, Kang Yang Chen, Shajal Alam, Jonathan H. V. PRICE, John R. Hayer, Dejas Liu, Andrew Malinowski, Christopher Cadamuro, Dehaese Ghelu, Moranay Pal, Shyamal K. Bhide, David J. Richardson; Univ. of Southampton, UK, Central Glass and Ceramic Res. Inst. Kolkata, India. We report picosecond fiber MOPA pumped supercontinuum source with 39 W output, spanning at least 0.4-1.75 µm with high and relatively uniform spectral power density of ~33.7 mW/nm corresponding to peak power density of ~12.5 W/mm in 20 ps pulse.

In the fusion of optics and microfluidics, we categorize the different possible tuning mechanisms in optofluidics and describe the recent examples in each category.

Cleaves and Challenges in the Patterning of a Novel Subwavelength Grating Structure, Goery Genty, Raphaël Codemard, Mohamed Chou, Claire Gmachl; 1Princeton Univ., USA, 2Shanghai Inst. of Technical Physics, Chinese Acad. Sci., 3Technical Univ. of Denmark, 4Qingdao Univ., China, 5Ferdinand-Braun-Inst. für Höchstfrequenztechnik, Germany.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
We observe the nonlinear THz spectroscopy of room-temperature grown InSb. We use terahertz pulses to probe the photoinduced changes in their properties and benchmark these observations. We find that the soft-mode resonance has been detected. The soft-mode resonance is attributed to a decreased damage threshold. We observe a stronger plasmonic resonance, but have not been able to stabilize dielectric films. Annealed nanoantennas were studied using ultrashort terahertz pulses generated using femtosecond mode-locked lasers. The damage threshold of gold nanoantennas was studied using terahertz spectroscopy and provided the information for further research.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
CTuV • Ultrafast Yb-Doped Sources—Continued

CTuV5 • 3:30 p.m.
Dual-Wavelength Mode-Locked Yb:YAG Ceramic Laser in Single Cavity, Hiroaki Yashoika1, Shinji Nakamura2, Takayuki Ogasawara Satohide Wada1; 1Gunma Univ., Japan, 2RIKEN, Japan. We demonstrated a 380 fs dual-wavelength independently mode-locked Yb:YAG ceramic laser at 1033.6 and 1047.6 nm. To the best of our knowledge, this is the first dual-wavelength mode locking achieved in Yb-doped solid-state lasers.

CTuV6 • 3:45 p.m.
Diode Laser Pumped Efficient Femtosecond Yb:YAG Ceramic Laser, Binbin Zhou1, Zhiyi Wu, Yuwan Zou1, Yongdong Zhang1, Xin Zhong1, 1, 2LULI, École Polytechnique, Planar, High Numerical-Aperture Lens Using Sub-Wavelength High Contrast Grating, Fangfu Fu, Forrest Selvig, Connie J. Chang-Hasnan; Univ. of California, Berkeley, USA. Planar lenses using sub-wavelength high contrast gratings are investigated. By designing the phase of the grating, high numerical aperture lenses can be achieved, with small spherical aberration and low insertion loss.

CTuV7 • 4:00 p.m.
Compact Femtosecond Laser System with 2 mJ Output, Evgueni Slobodtchikov, Peter F. Moulton; Q-Peak Inc., USA. 2 mJ, 600 fs, 1047 nm pulses at a 250 Hz rate from a compact, Yb-doped crystal CPA laser system were achieved. We combine a 250-Hz rate from a compact, Yb-doped crystal fiber with a hexagonal structure, optimizing the fiber pitch and pulse duration with a 2.8µm laser source in order to maximize the output bandwith.

Notes

CTuW • High-Contrast Periodic Reflector Devices—Continued

CTuW • High-Contrast Periodic Reflector Devices—Continued

CTuX • Super Continuum Fiber Source—Continued

CTuX5 • 3:30 p.m.
Extreme-Value Statistics in Supercontinuum Generation by Cascaded Stimulated Raman Scattering, Antti Al-toh, Goery Genty, John M. Dudley1, Tampere Univ. of Technology, Finland. Statistical fluctuations in cascaded stimulated Raman spectra are studied. The statistical distribution of shot-to-shot spectral variations evolves from a quasi-Gaussian to a long-tailed extreme-value distribution for Stokes orders at a large separation from the pump.

CTuX6 • 3:45 p.m.
Soliton Collision Induced Dispersive Wave Generation, Mire Erkintalo, Goery Genty, John M. Dudley1; 1Tampere Univ. of Technology, Finland, France. We show numerically in the context of supercontinuum generation in the long pulse regime that soliton collisions can lead to the generation of rare, extreme-amplitude dispersive waves with enhanced spectral shift.

CTuX7 • 4:00 p.m.
Maximizing the Supercontinuum Bandwidth in As3S2 Chalcogenide Photonic Crystal Fibers, Robert J. Weible1, Jonathan He1, Curtis R. Mer-nyak1, Brandon Shaw1, Jas S. Sanghera1, Ishtiaq D. Agarwala1; 1Univ. of Maryland Baltimore County, USA, 2NRL, USA. We simulate supercontinuum generation in an As3S2 chalcogenide photonic crystal fiber with a hexagonal structure, optimizing the fiber pitch and pulse duration with a 2.8µm laser source in order to maximize the output bandwith.

CTuY • Optofluidic Materials and Sensing Systems—Continued

CTuY5 • 3:45 p.m.
Optofluidic Three-Dimensional Self-Assembly of Vertically Patterned Microstructures Using Railed Microfluidics, Su Eun Chung, Yoonsik Jong, Sanghoon Kwon; Seoul Natl. Univ., Republic of Korea. We demonstrate optofluidic three-dimensional (3-D) vertical self-assembly of two-dimensionally patterned microstructures using railed microfluidics. 3-D railed assembly method is easy and fast vertical heterogeneous patterning and assembly technique.

CTuY6 • 4:00 p.m.
Self-Assembled Femtoliter-Scale Structures in a Hollow Optical Fiber for Optofluidic Applications, Sooroo An; Yonsei Univ., Republic of Korea. We propose self-assembled femtoliter-disk forma-technology. Three kind of structures are generated, also we see the optical property.
Room A5

QELS

QTuE • Two-Photon Processes—Continued

QTuE5 • 3:30 p.m. Invited
Two Photon Emission, Entanglement and Gain from Semiconductors at Room Temperature, Meir Orenstein, Alex Hayat, Amit Naveh, Pardal Ginzburg, Serge Rosenblum. Technion Israel Inst. of Technology, Israel. The first observation of two-photon emission from semiconductors and its applications are presented theoretically and experimentally. Entanglement sources are proposed and two-photon gain is measured in electrically-pumped devices at room temperature, promising giant pulse generation.

QTuE6 • 4:00 p.m.
Intensity Invariance of Strong Field Two-Photon Absorption, Songpyung Lee*, Jongyok Lee*, Yuye Hakobyan*, Stephanie Guérin*, Iarwook Ahn*; Korea Advanced Inst. of Science and Technology, Republic of Korea. We demonstrate experimentally and theoretically the intensity-invariant scaling formula of coherent control of two-photon absorption as a function of pulse-shape parameters of ultrafast laser field in the strong interaction regime.

Room A6

CLEO

CuTz • Quantum Dot and Quantum Dash Lasers—Continued

CuTz5 • 3:30 p.m.
Bandstructure Engineering with a Two-Dimensional Patterned Quantum Dot Lattice, Y. R. Verma, N. L. Dao, U. Reddy, K. P. Bennett, X. Li, J. J. Coleman; Univ. of Illinois at Urbana-Champaign, USA. A semiconductor laser with active layer consisting of a patterned quantum dot lattice demonstrates evidence of miniband formation resulting from inter-dot coupling. Excited state lasing is thought to result from a phonon bottleneck-like effect.

CuTz6 • 3:45 p.m.
Optically Injected Quantum Dash Lasers at 1550nm Employed as Highly Tunable Photonic Oscillators, Michael C. Pochet*, Nader A. Naderi*, Vassilios Kovanis*, Luke F. Lester*. Univ. of New Mexico, USA, USAFRL, USA. Experimental investigation of an optically-injected quantum-dash laser's operational map shows large regions of period-one operation. The enhanced and undamped relaxation oscillations of the period-one state are discussed as a building block for tunable photonic oscillators.

Room A7

CuTAA • CLEO Symposium on Novel Optical Fibers: Fibers for Telecommunications and Geophysics—Continued

CuTAA4 • 3:30 p.m.
Multimode Graded-Index Fluorine-Doped Fibers for Harsh Environments Fabricated by MCVD-Method, Sergei L. Semjonov*, Vladimir F. Khopin*, Mikhail Y. Salkanskiy*, Alexey N. Guryanov*, Alexey F. Kudelin*, Ivan V. Nikol*; Technion – Israel Inst. of Technology, Israel, Inst. of High Purity Substances, Russian Federation, Schlumberger Moscow Res., Russian Federation. Multimode graded-index fluorine-doped fibers with a record (for the MCVD method) value of the refractive index difference of -0.0115 (NA ~0.185) were fabricated and tested at high temperature (up to 300°C) in hydrogen atmosphere (50 atm).

CuTAA5 • 4:00 p.m.
Multimode Graded-Index Fluorine-Doped Fibers for Harsh Environments Fabricated by MCVD-Method, Sergei L. Semjonov*, Vladimir F. Khopin*, Mikhail Y. Salkanskiy*, Alexey N. Guryanov*, Alexey F. Kudelin*, Ivan V. Nikol*; Technion – Israel Inst. of Technology, Israel, Inst. of High Purity Substances, Russian Federation, Schlumberger Moscow Res., Russian Federation. Multimode graded-index fluorine-doped fibers with a record (for the MCVD method) value of the refractive index difference of -0.0115 (NA ~0.185) were fabricated and tested at high temperature (up to 300°C) in hydrogen atmosphere (50 atm).

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Room A1

4:45 p.m.–6:30 p.m.
CTuGG • Mid-IR Femtosecond Pulse Generation/Amplification
Irina T. Sorokina; Norwegian Univ. of Science and Technology, Norway, Presider

CTuGG1 • 4:45 p.m.
Fiber-Based, Soliton-Tuned Femtosecond Optical Source: Mid-Infrared Spectral Region, Randy Baradi, David Winters, Greg Futa, Philip Schimp, Colorado State Univ., USA. A fiber-based compact source of mid-infrared ultrafast laser pulses is presented. A polarization-maintaining fiber amplifier provides the pump pulses, while the signal pulses are derived from the same source by soliton self-frequency shifting in the same fiber. Noise and jitter of the fiber pulses are characterized.

Room A2

4:45 p.m.–6:30 p.m.
CTuHH • Slow and Fast Light in High Index Contrast Systems
Chee Wei Wong; Columbia Univ., USA, Presider

CTuHH1 • 4:45 p.m.
1 GHz Femtosecond Erbium-doped Fiber Laser, Michelle V. Sander, Hyun Min Ryan, Jonathan Morse, David Chan, Han-Jin M. Shon, Ali Mostakely, Gale Petrich, Leslie Kolodziejski, Eric P. Ippen, Franz K. Kärtner, MIT, USA. Saturable Bragg reflector (SBR)-mode-locked Er doped fiber lasers around 1550 nm with a repetition rate of 1GHz are demonstrated. Key steps to obtain stable, femtosecond pulses by avoiding thermal damage of the SBR are discussed.

Room A3

4:45 p.m.–6:30 p.m.
CTuU • Saturable Absorber Mode-Locked Fiber Lasers
Kazi S. Abedin; NICT, Japan, Presider

CTuU1 • 4:45 p.m.
Optical Performance Monitoring at 640Gb/s Based on Short Light on a Chip, William L. Corcoran, christelle Monnet, Mark Peluso, Christian Grillot, Tom White, Liam O’Farrell, Thomas F. Krauss, Ali Mostakely, Steven L. Neale, Hsin-Yin Hsu, Arash Jamshidi, Ethan Schonbrun, Paul E. Steinvurzel, Kenneth R. Creaser, Harvard Univ., USA. Using a microfabricated zone plate array, we demonstrate detection of fluorescent beads at 12 locations along a serpentine microfluidic channel. Cross-correlations of the signals along the channel enable velocity dispersion measurements.

Room A4

4:45 p.m.–6:30 p.m.
CTuJ • Optofluidic Trapping, Sorting and Manipulation
David Erickson; Cornell Univ., USA, Presider

CTuJ1 • 4:45 p.m.
Multipoint Microfluidic Detection Using an Integrated Zone Plate Array, Ethan Schonbrun, Paul E. Steinvurzel, Kenneth R. Creaser, Harvard Univ., USA. A microfabricated zone plate array is used to interrogate microfluidic devices at 12 locations along a serpentine microfluidic channel. Cross-correlations of the signals along the channel enable velocity dispersion measurements.
Ultra-Long-Lived Molecular Coherence in H2: A delayed probe-pump technique shows the persistence of molecular coherence of rotational and vibrational modes over a time scale ~42 times longer than the dephasing time.

Observation of Four-Wave Mixing Conversion Efficiency and Bandwidth in Silicon Photonic Crystal Waveguides: We present observations of slow-light enhanced four-wave mixing in silicon photonic crystal waveguides (11-dB enhancement in idler conversion efficiency), with a corresponding reduction in conversion bandwidth due to increased group velocity dispersion.

Generation of 5-6 fs Pulses Tunable from 400 to 120 nm by Kagome-Lattice Hollow-Core PCF: We predict the generation of isolated UV/VUV 5-6 fs pulses from Ti:sapphire laser pulses during spectral broadening in argon-filled kagome-cladding PCF. The spectral position of the pulse can be easily tuned by changing the pressure.

Comparisons between Linear and Nonlinear Localized Waves in Semiconductor Lasers within a Surface Photonic Crystal Structure: We report experimental observations of cavity solitons in a surface-photonic-crystal-structured VCSEL by the near-field scanning optical microscope. Comparisons between linear defect modes and cavity solitons are illustrated experimentally and numerically.

Direct Observation of Two-Photon Gain in Semiconductors, Amite Nevet, Alex Hayat, Meir Orenstein, Technion, Israel. We report the first observation of two-photon gain in solids, specifically in electrically-pumped room-temperature semiconductor devices. Structures optimized to enhance the nonlinear two-photon interaction and reduce parasitic effects yielded gain in excellent agreement with theory.

Two-Dimensional Fiber lasers for Tunable, Narrow LineWidth, mm-Wave Signal Generation, Marco Soldo1, Marco Zanola2, Marco Zanolla3, Michael J. Strain2, Marc Sorel1, Guido Giuliani1; 1Univ. di Pavia, Italy, 2Univ. of Glasgow, UK. An integrated monolithic device where two DFB lasers are phase-locked via mutual injection, assisted by a Four-Wave-Mixing process that takes place in an auxiliary DFB, generates a spectrally pure tunable mm-wave signal.

Dual Wavelength Gain Guided Broad Area Semiconductor Lasers, Uttam Ruddy, Neville L. Dua, Akshay Garg, Varan B. Verma, Jonathan D. Young, James J. Coleman; Univ. of Illinois at Urbana-Champaign, USA. A monolithically integrated dual wavelength semiconductor laser for optical heterodyning is presented. We present a novel laser design which employs surface etched DBR gratings in order to obtain lasing at very narrow line widths.

Dual Wavelength Gain Guided Broad Area Semiconductor Lasers, Uttam Ruddy, Neville L. Dua, Akshay Garg, Varan B. Verma, Jonathan D. Young, James J. Coleman; Univ. of Illinois at Urbana-Champaign, USA. A monolithically integrated dual wavelength semiconductor laser for optical heterodyning is presented. We present a novel laser design which employs surface etched DBR gratings in order to obtain lasing at very narrow line widths.

Wideband Polarization-Maintained PCF with Cylindrically Symmetric hole Arrangements, E. A.劳动者, C. S. Yeung, J. W. S. Leung, M. T. K. Ho, M. C. W. Chan, Y. H. Leung, Y. H. Chung; Univ. of Hong Kong, Hong Kong, China. A wideband polarization-maintaining PCF with a core-cladding index contrast so that only two modal bands.

Enhanced Four-Wave Mixing in Silicon Photonic Crystal Waveguides, James F. McMillan1, Minghui Ye1, Dim-Lee Kwong2, Chee-Wei Wong1; 1Optical Fiber with Large Mode Area Behavior, 2Optoelectronics Res. Ctr., Univ. of Southampton, UK. A monolithically integrated dual wavelength semiconductor laser for optical heterodyning is presented. We present a novel laser design which employs surface etched DBR gratings in order to obtain lasing at very narrow line widths.

Observation of Four-Wave Mixing Conversion Efficiency and Bandwidth in Silicon Photonic Crystal Waveguides, James F. McMillan1, Minghui Ye1, Dim-Lee Kwong2, Chee-Wei Wong1; 1Optical Fiber with Large Mode Area Behavior, 2Optoelectronics Res. Ctr., Univ. of Southampton, UK. A monolithically integrated dual wavelength semiconductor laser for optical heterodyning is presented. We present a novel laser design which employs surface etched DBR gratings in order to obtain lasing at very narrow line widths.
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4:45 p.m.–6:30 p.m.  CtuMM • THz Quantum Cascade Lasers  Sasuk Kumar; MIT, USA, President

4:45 p.m.  CtuNN • Microscopy and Interferometry  R. Jason Jones; Univ. of Arizona, USA, President

4:45 p.m.–6:30 p.m.  QtuH • QELS Symposium on Nanophotonics and Metamaterials III: Metamaterials  Natasha Litchinitser; SUNY Buffalo, USA, Chairman

CTuMM1 • 4:45 p.m.  Phase-Locked Arrays of Surface-Emitting Terahertz Quantum Cascade Lasers, Tsung Yu Kao1, Qing Hua1, John L. Reno2; MIT, USA, 1Sandia Natl. Labs, USA. We report single-mode operation of phase-locked arrays of surface-emitting distributed-feedback terahertz quantum-cascade lasers. Carefully-designed phase-sector laser arrays in phase, creating tighter beam-patterns along the phased-array direction (FWHM~10deg). This method allows beam-steering applications at terahertz frequencies.

CTuMM2 • 5:00 p.m.  Quantum Cascade Laser to a Femtosecond Mode-Locked Er,Fiber Laser, Stefano Barbieri1, Giorgio Santandri2, Piergiulio Lus1, Massimiliano Imonti1; Wilfried Mainz1, Carlo Sitter1, Raffaele Colombelli1, Harvey Beren1, David Ritchie1; EHE-EPFL, 2Ecole EPFL, Switzerland. We report a 3.7 Terahertz Quantum Cascade Laser operating at a repetition rate of the commercial Er-doped fiber laser. We observe a linewidth of the beatnote signal with a signal-to-noise ratio of 98dB in 1Hz bandwidth.

CTuMM3 • 5:15 p.m.  Ultrastable Atomic Force Microscopy Using Laser-Based, Active Noise Cancellation, Thomas T. Perkins1, Kevin M. King1, Allison B. Churnside2, Ashley R. Carter3, Gavin H. Carter1, JILA, NIST, Univ. of Colorado at Boulder, USA. We achieved a 100-fold improvement in tip-sample stability by stabilizing the tip and the sample in 3-D using laser light back-scattered off the apex of an AFM tip and a reference mark in the sample.

CTuNN1 • 4:45 p.m.  Plasma-enhanced Light Emission from InGa...Enhanced LEDs  E. Fred Schubert; Rensselaer Polytechnic Inst., USA, President

CTuNN2 • 5:00 p.m.  Low Temperature Near-Field Scanning Optical Microscopy of 1R and THz Surface-Plasmon Quantum Cascade Lasers, Joon C. Moldovan-Dayen1, Arthur Babuty1, Adel Bouabdad1, Rafiue Colombelli1, Samuil Gérald1, Yannick De Wilde1; 1Institut de Physique de Rennes, Université de Rennes 1, Rennes, France, 2CEA, DAM, DAM06, France. We present the first scanning type near-field scanning optical microscope operating at low temperature. This instrument is ideal to study infrared and terahertz QCLs combined with metallic photonic crystal resonators and surface plasmon waveguides.

CTuNN3 • 5:15 p.m.  Three-dimensional Invisibility-Cloaking Structure at Optical Frequencies, Jörg Eigen1, Nicolas Steger1, Martin Wegener1; 1Institut für Angewandte Physik, Karlsruhe Institute of Technology (KIT), Germany, 2DFG-Ctr. for Functional Nanostructures (CNF), Karlsruhe Inst. of Technology (KIT), Germany. We realize a three-dimensional invisibility-cloaking structure operating at optical frequencies. We employ a woodpile photonic crystal in the long-wavelength limit with tailored polymer filling fraction to hide a bump in a gold reflector.

CTuNN4 • 5:30 p.m.  Contact Printing of Quantum Dot Light Emitting Diodes on Silicon Probe Tip, Kazuhiro Hashima, Atsushi Gokai, John J. Zhang; Univ. of Texas at Austin, USA. A novel quantum dot based LED is fabricated directly on a micromachined silicon probe. Monolayers of quantum dots are precisely deposited at the probe tip through microcontact printing and electrically excited to show successful electroluminescence.
Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Room A1

**CLEO**

**CtUG** • Mid-IR Femtosecond Pulse Generation/Amplification—Continued

**CtUG** • 6:15 p.m.

Dynamics of Nonlinear Loss in a Silicon Slow Light Photonic Crystal Waveguide, Bill Carcione, Christelle Monat, Dominik Puda, Mark Pelaez, David J. Moss, Benjamin J. Eggleton, Thomas P. White, Liam O’Faolain, and Thomas F. Krauss; 1Stanford Univ., USA, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We directly investigate the influence of nonlinear loss dynamics on a slow-light silicon waveguide optical limiter, mapping how the response of free carrier absorption varies as intensity changes approach the free carrier recombination time.

**CtUG** • 6:15 p.m.

Generation of Frequency-Doubled 55 fs Pulses from an Erbium Fiber Laser System, Robert Herda, Andreas Brandstecher, Thomas Hellrter, Frank Lison, TOPTICA Photonics AG, Germany. 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.

**CtUG** • 6:15 p.m.

Particle Size Limits of Optical Trapping and Deflection for Sorting Using Diode Laser Bars, Robert W. Applegate, David W. M. Marr, Jeff Squier, Steven W. Games; 1Univ. of New Mexico, USA, 2Colorado School of Mines, USA. We model and examine advantages and limitations of diode laser bar trapping for manipulating particles greater than 100 µm in diameter. This method overcomes limitations that prevent conventional point traps from effectively directing large particles.

**CtUG** • 6:00 p.m.

Slow-Light Silicon Mach-Zehnder Modulator Based-on Cascaded Ring Resonators, Suguru Akiyama, Tetsuro Karasuba, Takeshi Baba, Nobuaki Okada, Ryoji Yamanishi, and Tatsuya Hatori; Fujitsu Ltd., Japan. Slow-light Mach-Zehnder modulator on SOI substrate is developed, which utilizes cascaded ring resonators in all-pass filter configuration. A fabricated device shows seven-fold enhancement in modulation efficiency, compared with a conventional modulator.

**CtUG** • 6:00 p.m.

Slow-Light Nonlinear Optics, Andreas Brandstecher, Thomas Hellrter, Frank Lison, TOPTICA Photonics AG, Germany. We achieve 9.73GHz pulsed operation in a short cavity fiber Fabry-Perot lasers using a heavily doped Er:Yb fiber and a saturable absorber consisting of a Carbon Nanotube film optically deposited into a highly reflective mirror.

**CtUG** • 5:45 p.m.

Bismuth-Doped Fiber Integrated Ring Laser Mode-Locked with a Nanotube-Based Saturable Absorber, Y. J. Koh, J. C. Travers, and E. J. R. Kelleher; 1CUDOS / IPOS, School of Physics, Univ. of Sydney, Australia, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We report on recent studies on high power photonic quantum ring lasers for improved massive micro-manipulation of biological cells or small particles in microfluidic channel.

**CtUG** • 5:45 p.m.

Bismuth Doped Fiber Ring Laser Amplifiers, Tatsuya Usuki, Tsuyoshi Yamamoto; Fujitsu Labs., Japan. All-normal dispersion and average soliton regime is obtained, with an all-fiber integrated format.

**CtUG** • 5:45 p.m.

Bismuth Doped Fiber Integrated Ring Laser Mode-Locked with a Nanotube-Based Saturable Absorber, Y. J. Koh, J. C. Travers, and E. J. R. Kelleher; 1CUDOS / IPOS, School of Physics, Univ. of Sydney, Australia, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We demonstrate passive mode-locking of a bismuth-doped fiber laser using a single-wall nanotube-based saturable absorber. Stable operation in the all-normal dispersion and average soliton regime is obtained, with an all-fiber integrated format.

**CtUG** • 5:45 p.m.

Nanoscale ring resonators by grating design, Ursula Keller, Martin M. Fejer, and Dominik Pudo; 1CUDOS / IPOS, School of Physics, Univ. of Sydney, Australia, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We directly investigate the influence of nonlinear loss dynamics on a slow-light silicon waveguide optical limiter, mapping how the response of free carrier absorption varies as intensity changes approach the free carrier recombination time.

**CtUG** • 5:45 p.m.

Dynamics of Nonlinear Loss in a Silicon Slow Light Photonic Crystal Waveguide, Bill Carcione, Christelle Monat, Dominik Puda, Mark Pelaez, David J. Moss, Benjamin J. Eggleton, Thomas P. White, Liam O’Faolain, and Thomas F. Krauss; 1Stanford Univ., USA, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We directly investigate the influence of nonlinear loss dynamics on a slow-light silicon waveguide optical limiter, mapping how the response of free carrier absorption varies as intensity changes approach the free carrier recombination time.

**CtUG** • 6:00 p.m.

1GHz Pulsed Er:Yb Fiber Laser Using an Optically Deposited Carbon-Nanotube Film in a Fiber Mirror, Amos Martinez, Kazuaki Fuse, Shinya Yamashita; Univ. of Tokyo, Japan. We achieve 9.73GHz pulsed operation in a short cavity fiber Fabry-Perot lasers using a heavily doped Er:Yb fiber and a saturable absorber consisting of a Carbon Nanotube film optically deposited into a highly reflective mirror.

**CtUG** • 6:00 p.m.

Slow-Light Mach-Zehnder Modulator Based-on Cascaded Ring Resonators, Suguru Akiyama, Tetsuro Karasuba, Takeshi Baba, Nobuaki Okada, Ryoji Yamanishi, and Tatsuya Hatori; Fujitsu Ltd., Japan. Slow-light Mach-Zehnder modulator on SOI substrate is developed, which utilizes cascaded ring resonators in all-pass filter configuration. A fabricated device shows seven-fold enhancement in modulation efficiency, compared with a conventional modulator.

**CtUG** • 6:00 p.m.

1GHz Pulsed Er:Yb Fiber Laser Using an Optically Deposited Carbon-Nanotube Film in a Fiber Mirror, Amos Martinez, Kazuaki Fuse, Shinya Yamashita; Univ. of Tokyo, Japan. We achieve 9.73GHz pulsed operation in a short cavity fiber Fabry-Perot lasers using a heavily doped Er:Yb fiber and a saturable absorber consisting of a Carbon Nanotube film optically deposited into a highly reflective mirror.

**CtUG** • 6:00 p.m.

Bismuth Doped Fiber Integrated Ring Laser Mode-Locked with a Nanotube-Based Saturable Absorber, Y. J. Koh, J. C. Travers, and E. J. R. Kelleher; 1CUDOS / IPOS, School of Physics, Univ. of Sydney, Australia, 2School of Physics and Astronomy, Univ. of St. Andrews, UK. We demonstrate passive mode-locking of a bismuth-doped fiber laser using a single-wall nanotube-based saturable absorber. Stable operation in the all-normal dispersion and average soliton regime is obtained, with an all-fiber integrated format.

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Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
Room A8

CuTuMM • THz Quantum Cascade Lasers—Continued

CuTuM4 • 5:45 p.m.
Broadband THz Lasing from a Photon-Phonon Quantum Cascade Structure Emitting from 2.8 to 4.1 THz, Giacomo Scalari; Maria I. Amanti, Romain Tenazet, Mattias Beck, Christoph Wulfer, Jerome Fast; ETH Zurich, Switzerland. Laser emission over a broad range of frequencies from 2.8 to 4.1 THz is reported from a two-quantum well, photon-phonon cascade structure with peak powers exceeding 30 mW in a double-metal waveguide.

Room C1&2

CuTuNN • Nanostructure Enhanced LEDs—Continued

CuTuNN5 • 5:45 p.m.
Polychromatic controlled Visible/IR Electroluminescence in Si-nanocrystal/Si Light-emitting Diodes, Jianmin Bai; Shangdong University, USA. We report on the demonstration of room-temperature two-color Si-nanocrystal/Si light-emitting diodes, which emit infrared light from silicon and visible emission from the Si-nanocrystal film when Si substrate is forward and reverse biased, respectively.

Room C3&4

CuTuOO • Microscopy and Interferometry—Continued

CuTuOO4 • 5:45 p.m.
Prism-Pair Interferometer for Precise Refractive Index Measurement Using Spectral Lamp Radiation with Simultaneous Wavelength Calibration, Yasunori Aoki, Akihiro Hirai, Naoki Minoshima; Natl. Inst. of Advanced Industrial Science and Technology, Japan. We developed a prism-pair interferometer which measures precise refractive index of glasses while ensuring the SI-traceability of a lamp wavelength. The measurement result agrees with manufacturer's value within ±10⁻⁶.

San Jose Ballroom IV (San Jose Marriott)

QELS

QTuH • QELS Symposium on Nanophotonics and Metamaterials III: Metamaterials—Continued

QTuH5 • 6:00 p.m.
Experimental Observation of the Trapped Rainbow, Igor V. Smolyaninov1, Vera Smolyaninova1, Alexander V. Kildishev, Vladimir M. Shalaev2, RAE Systems, USA, “Dowson Univ., USA, “Purdue Univ., USA. We report on the experimental demonstration of the broadband “trapped rainbow” in the visible range using an adiabatically tapered waveguide. Being a distinct case of the slow light phenomenon, this effect can enhanced light-matter interactions.

QTuH6 • 6:15 p.m.
New Concepts in Spoofer Surface Plasmon Polariton Metamaterials, Stefan Maier; Experimental Solid State Group, Dept. of Physics, Imperial College London, UK. New approaches to create high-confinement surface waveguides based on spoofer plasmon polaritons in the infrared part of the spectrum will be presented, focusing on structures with improved trade-off between bandwidth and confinement.

NOTES
### CLEO: Applications

#### ATuB • Optical Communications Techniques and Components—Continued

**ATuB4 • 5:45 p.m.**
Towards the Implementation of an Organic Inorganic Laser for Next Generation Optical Applications, Giorgio Maria Tosi Belfelli, Stefano Peroni, Hari Bhardwaj, Sandipan Basu, Laura Scuderi, Valentina Vincenzi, Vincent L. Assistant Professor, Directors of the Optical Communication Laboratory, University of Verona, Italy, and the University of California, Berkeley, USA.

**ATuB5 • 6:00 p.m.**
Nonlinear Optical Phenomena and Filamentation—Continued

**ATuB6 • 6:15 p.m.**
Aerogel Package for Fused Fibre Couplers, Limin Xiao, Michael Grogan, Richard England, William Wadsworth, Tim Birks, University of Bath, UK. Fused fibre couplers were encapsulated in hydrophobic aerogel. This provides an epoxy-free all-silica package that is low-loss, waterproof, supports the whole coupler waist and is stable up to 250°C.

#### CtUPP • Nonlinear Optical Phenomena and Filamentation—Continued

**CtUPP5 • 5:45 p.m.**
Determination of the Transient Electron Temperature in Femtosecond Laser-Induced Air Plasma, Zhanliang Sun, Jinhai Chen, Wolfgang Rudolph, University of New Mexico, USA. The transient electron temperature in a fs laser air plasma (filament) was determined with ps resolution from pump-probe diffraction and absorption measurements. Plasma modeling shows good agreement with experiments if inelastic collisions are included.

**CtUPPP • 6:00 p.m.**
Nonlinear Phase Contrast Enhancement, Alexandre S. Guy, Demoitri Pitsalis, École Polytechnique Fédérale de Lausanne, Switzerland.

**CtUPP6 • 6:15 p.m.**
Optical Resolution Enhancement with Phase-Sensitive Preamplification, On Kaw Lim, Gideon Alon, Zachary Dutton, Saikat Guha, Michael Vlasek, Prem Kumar, Northwestern Univ., USA. In one versus two-target experiment we distinguish otherwise unresolved images with higher probability after such amplification than is possible without amplification.

#### CtUQQ • High Power Lasers—Continued

**CtUQQA • 5:45 p.m.**
Yb-Doped Sesquioxide Thin Disk Lasers Exceeding 300 W of Output Power in Continuous-Wave Operation, Christian Kränkel, Rigo Peteri, Oliver H. Hackl, Cyril E. E. Bart, Clara J. Saraceni, Rolja Bell, Thomas Sidemeyer, Klaus Petermann, Ursula Keller, Günter Huber, Institute of Quantum Electronics, ETH Zurich, Switzerland. We report on VBG-diode-pumped Yb:La2O3, Yb:Sc2O3, and Yb:LaScO3 thin disk lasers delivering more than 250 W of output power at optical-to-optical efficiencies up to 73%. 140 W of fundamental-mode output power were obtained with Yb:La2O3.

**CtUQQB • 6:00 p.m.**
Diode-Pumped Nd:YAG Self-Adaptive Resonator with a High Gain Amplifier Operating at 100 Hz, Rémi Soulard, Arnaud Bignier, Stephanie Durand, Thales, France. We report on a self-adaptive laser resonator operating at 100Hz and delivering 100mJ, 20ns pulses.

**CtUQQC • 6:15 p.m.**
Efficient Heat Removal from Laser Crystal with Chemical Vapor Deposited Diamond Heat Spreader, Xiaodong Ma, Xudong Li, Huai-Chun Lee, Shinwa Optics, Inc., USA. By using a chemical vapor deposited diamond wafer as heat spreader between a YAG and a copper heat sink, a 3.6 times higher effective heat transfer coefficient has been measured compared with conventional indium contact.

### Concurrent Sessions

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