PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 7582

, "Front Matter: Volume 7582," Proc. SPIE 7582, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications IX, 758201 (15 March 2010); doi: 10.1117/12.855216

SPIE.

Event: SPIE LASE, 2010, San Francisco, California, United States

PROCEEDINGS OF SPIE

Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications IX

Peter E. Powers
Editor

**25–28 January 2010
San Francisco, California, United States**

Sponsored and Published by
SPIE

Volume 7582

Proceedings of SPIE, 0277-786X, v. 7582

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications IX*, edited by Peter E. Powers, Proceedings of SPIE Vol. 7582 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X

ISBN 9780819479785

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

Copyright © 2010, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/10/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

- ix Conference Committee
- xi *Ultrafast fiber laser technology: status and prospects (Plenary Paper) [7579-102]*
A. Tünnermann, J. Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institute for Applied Optics and Precision Engineering (Germany)

SESSION 1 VISIBLE AND UV LASERS: JOINT SESSION WITH CONFERENCES 7578 AND 7580

- 7582 02 **Highly efficient and compact microchip green laser source for mobile projectors (Invited Paper) [7582-01]**
J. Khaydarov, S. Essaian, G. Nemet, A. Shchegrov, N. Simanovskaia, Spectralus Corp. (United States); H. Danielyan, G. Gabrielyan, A. Poghosyan, S. Soghomonyan, Spectralus C.JSC (Armenia)
- 7582 03 **High-power green light generation by second harmonic generation of single-frequency tapered diode lasers [7582-02]**
O. B. Jensen, P. E. Andersen, Technical Univ. of Denmark (Denmark); B. Sumpf, K.-H. Hasler, G. Erbert, Ferdinand-Braun-Institut für Höchstfrequenztechnik (Germany); P. M. Petersen, Technical Univ. of Denmark (Denmark)

SESSION 2 VISIBLE SOURCES

- 7582 04 **Compact module of a frequency-doubled, CW diode laser with an output power of more than 500 mW at 531 nm and a beam quality of less than 1.3 [7582-03]**
J. Wueppen, E. Pawlowski, M. Traub, B. Jungbluth, Fraunhofer-Institut für Lasertechnik (Germany); K.-H. Hasler, B. Sumpf, G. Erbert, Ferdinand-Braun-Institut für Höchstfrequenztechnik (Germany)
- 7582 05 **Efficient green lasers for high-resolution scanning micro-projector displays (Invited Paper) [7582-04]**
V. Bhatia, A. S. Bauco, H. M. Oubei, D. A. S. Loeber, Corning Inc. (United States)
- 7582 06 **Simultaneous blue and red light generation with birefringent phase matching [7582-05]**
K. Miyata, N. Umemura, K. Kato, Chitose Institute of Science and Technology (Japan)
- 7582 07 **High performance at low cost: the challenge of manufacturing frequency doubled green semiconductor lasers for mass markets (Invited Paper) [7582-06]**
T. Hoefer, M. Schmitt, T. Schwarz, M. Kuehnelt, R. Schulz, I. Pietzonka, H. Lindberg, C. Lauer, S. Lutgen, U. Steegmueller, U. Strauss, OSRAM Opto Semiconductors GmbH (Germany)

SESSION 3 ULTRAFast NONLINEAR DEVICES AND APPLICATIONS I

- 7582 09 **Modeling of optical frequency comb generation in whispering gallery mode resonators and limiting effects** [7582-08]
Y. K. Chembo, N. Yu, Jet Propulsion Lab. (United States)
- 7582 0B **White light generation and pulse compression with a Ti:Sapphire high energy oscillator** [7582-10]
W. Koehler, G. Tempea, FEMTOLASERS Produktions GmbH (Austria)
- 7582 0D **Tunable broadband optical generation via giant Rabi shifting in micro-plasmas** [7582-12]
R. Compton, A. Filin, D. A. Romanov, R. J. Levis, Temple Univ. (United States)

SESSION 4 OPTICAL PARAMETRIC DEVICES

- 7582 0E **LiInSe₂ nanosecond optical parametric oscillator tunable from 4.7 to 8.7 μ m** [7582-13]
A. Tyazhev, G. Marchev, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); V. Vedenyapin, Institute of Mineralogy and Petrography (Russian Federation); D. Kolker, Novosibirsk State Technical Univ. (Russian Federation); A. Yelisseyev, S. Lobanov, L. Isaenko, Institute of Mineralogy and Petrography (Russian Federation); J.-J. Zondy, Conservatoire National des Arts et Métiers (France); V. Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany)
- 7582 0F **6.3 Watt single frequency CW source at 780nm based on frequency conversion of a fiber laser** [7582-14]
A. Henderson, P. Esquinasi, M. Levin, Lockheed Martin Aculight (United States)
- 7582 0G **Synchronously pumped at 1064 nm OPO based on CdSiP₂ for generation of high-power picosecond pulses in the mid-infrared near 6.4 μ m** [7582-15]
A. Peremans, D. Lis, F. Cecchet, Univ. of Namur (Belgium); P. G. Schunemann, K. T. Zawilski, BAE Systems (United States); V. Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany)
- 7582 0H **A high peak power, compact, eye-safe optical parametric oscillator system** [7582-16]
F. F. Wu, J. W. Pierce, JP Innovations LLC (United States)
- 7582 0I **Excitation of individual Raman Stokes lines of up-to ninth order using rectangular shaped optical pulses at 530 nm** [7582-17]
K. K. Chen, S. Alam, C. A. Codemard, A. Malinowski, D. J. Richardson, Univ. of Southampton (United Kingdom)

SESSION 5 NONLINEAR OPTICS FOR SPECTROSCOPIC APPLICATIONS

- 7582 0J **Tunable nonlinear-optical devices for laser-spectroscopic sensing (Invited Paper)** [7582-18]
B. J. Orr, Y. He, Macquarie Univ. (Australia)
- 7582 0K **Seeded nanosecond optical parametric generator for trace gas measurements** [7582-19]
K. Numata, Univ. of Maryland, College Park (United States); S. Li, H. Riris, S. Wu, A. Seas, A. Yu, M. Krainak, J. Abshire, NASA Goddard Space Flight Ctr. (United States)

- 7582 OM **Filament-based stimulated Raman spectroscopy** [7582-21]
J. H. Odnher, D. A. Romanov, R. J. Levis, Temple Univ. (United States)
- 7582 ON **Generation of quasi-continuous wave 389-nm coherent light by frequency doubling of a Ti:sapphire laser for nuclear spin polarization of ^3He atoms** [7582-22]
S. Maeda, H. Morioka, T. Ohira, H. Kumagai, A. Kobayashi, Osaka City Univ. (Japan)
- 7582 OO **Continuous-wave optical parametric oscillators on their way to the terahertz range** [7582-60]
R. Sowade, I. Breunig, J. Kiessling, K. Buse, Univ. Bonn (Germany)

SESSION 6 NONLINEAR FIBER DEVICES AND APPLICATIONS

- 7582 OP **Bound states of dissipative solitons in optical fiber systems** [7582-23]
S. C. V. Latas, M. F. S. Ferreira, Univ. de Aveiro (Portugal)
- 7582 OQ **Extraction of a single soliton from a bunch of solitons generated by pulse breakup** [7582-24]
M. A. Bello-Jimenez, E. A. Kuzin, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); O. Pottiez, Ctr. de Investigaciones en Óptica, A.C. (Mexico); B. Ibarra-Escamilla, A. Flores-Rosas, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); M. Duran-Sanchez, Univ. Tecnológico de Puebla (Mexico)
- 7582 OR **Self-focusing in gain-guided optical fibers and pulse propagation characteristics** [7582-25]
R. Zhou, Univ. of Dayton (United States); B. Ibarra-Escamilla, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); J. W. Haus, P. E. Powers, Q. Zhan, Univ. of Dayton (United States)
- 7582 OS **Monolithic high SBS threshold pulsed fiber laser and frequency doubling for LIDAR and remote sensing spectroscopy** [7582-26]
W. Shi, NP Photonics, Inc. (United States); E. B. Petersen, NP Photonics, Inc. (United States) and The Univ. of Arizona (United States); D. T. Nguyen, Z. Yao, J. Zong, NP Photonics, Inc. (United States); M. A. Stephen, NASA Goddard Space Flight Ctr. (United States); A. Chavez-Pirson, NP Photonics, Inc. (United States); N. Peyghambarian, NP Photonics, Inc. (United States) and College of Optical Sciences, The Univ. of Arizona (United States)
- 7582 OT **Experimental demonstration of fiber optical parametric chirped-pulse amplification** [7582-27]
Y. Zhou, K. K. Y. Cheung, P. C. Chui, K. K. Y. Wong, The Univ. of Hong Kong (Hong Kong, China)
- 7582 OU **Far-UV solid state lasers for semiconductor processing (Invited Paper)** [7582-28]
J. Jacob, Actinix (United States); D. Armstrong, Sandia National Labs. (United States); A. Smith, AS-Photonics, LLC (United States)

SESSION 7 TERAHERTZ GENERATION

- 7582 0V **Single-frequency pulsed fiber lasers at ~1.5 μm and fiber-based narrow linewidth THz sources (Invited Paper)** [7582-29]
W. Shi, NP Photonics, Inc. (United States); E. B. Petersen, NP Photonics, Inc. (United States) and The Univ. of Arizona (United States); D. T. Nguyen, J. Zong, Z. Yao, A. Chavez-Pirson, NP Photonics, Inc. (United States); N. Peyghambarian, NP Photonics, Inc. (United States) and College of Optical Sciences, The Univ. of Arizona (United States)
- 7582 0W **Enhancement of optics-to-THz conversion efficiency by metallic slot waveguides** [7582-30]
Z. Ruan, Stanford Univ. (United States); G. Veronis, Louisiana State Univ. (United States); K. L. Vodopyanov, M. M. Fejer, S. Fan, Stanford Univ. (United States)
- 7582 0Y **Terahertz and optical frequency mixing in semiconductor quantum-wells** [7582-32]
Y.-S. Lee, A. D. Jameson, J. L. Tomaino, Oregon State Univ. (United States); J. P. Prineas, The Univ. of Iowa (United States); J. T. Steiner, M. Kra, S. W. Koch, Philipps-Univ. Marburg (Germany)
- 7582 0Z **THz-wave generation inside a high-finesse ring-cavity OPO pumped by a fiber laser** [7582-33]
W. C. Hurlbut, V. G. Kozlov, Microtech Instruments, Inc. (United States); K. Vodopyanov, Stanford Univ. (United States)
- 7582 10 **Broadly tunable terahertz source** [7582-34]
P. E. Powers, K. Kramb, J. W. Haus, Univ. of Dayton (United States)

SESSION 8 ENGINEERED NONLINEAR OPTICS

- 7582 11 **Periodically poled silicon (Invited Paper)** [7582-35]
N. K. Hon, K. K. Tsia, D. R. Solli, Univ. of California, Los Angeles (United States); J. B. Khurgin, Johns Hopkins Univ. (USA); B. Jalali, Univ. of California, Los Angeles (United States)
- 7582 12 **Polarization effects and fiber-laser-pumping of a 2- μm -pumped OP-GaAs OPO (Invited Paper)** [7582-36]
C. Kieleck, M. Eichhorn, Institut Franco-Allemand de Recherches de Saint-Louis (France); D. Faye, E. Lallier, Thales Research & Technology (France); S. D. Jackson, The Univ. of Sydney (Australia)
- 7582 14 **Adhesive-free bond quasi-noncritical phase-matched and quasi-phase-matched optical parametric oscillations** [7582-38]
X. Mu, H. Meissner, H.-C. Lee, Onyx Optics Inc. (United States)

SESSION 9 ULTRAFAST NONLINEAR DEVICES AND APPLICATIONS II

- 7582 15 **Mode-locking with phase-sensitive (parametric) amplification** [7582-39]
S. Hachey, C. R. Jones, J. N. Kutz, Univ. of Washington (United States)
- 7582 16 **Mode-locked laser pulse sources for wavelength division multiplexing** [7582-40]
E. Farnum, Kean Univ. (United States); B. G. Bale, Aston Univ. (United Kingdom); J. N. Kutz, Univ. of Washington (United States)

7582 17 **Dynamics of ultrashort pulse solutions of the complex Ginzburg-Landau equation** [7582-41]
S. C. V. Latas, M. F. S. Ferreira, M. V. Facão, Univ. de Aveiro (Portugal)

7582 18 **Novel high-sensitivity Z-scan technique based on a Hartmann-Shack wavefront sensor**
[7582-42]
D. Rativa, B. Vohnsen, Univ. College Dublin (Ireland); A. S. L. Gomes, R. E. de Araujo, Univ.
Federal de Pernambuco (Brazil)

SESSION 10 NONLINEAR MATERIALS AND CHARACTERIZATION

7582 19 **The physical basis and modeling of Cr⁴⁺-based saturable absorbers (Invited Paper)**
[7582-43]
Y. Kalisky, Nuclear Research Ctr. Negev (Israel); O. Kalisky, Jerusalem College of Technology
(Israel)

7582 1A **Comparison of nonlinear absorption and carrier recombination times in GaAs grown by
hydride vapor phase epitaxy and Bridgman processes** [7582-44]
L. P. Gonzalez, Air Force Research Lab. (United States); J. Murray, A. Carpenter,
D. Upchurch, J. O. Barnes, Air Force Research Lab. (United States) and General Dynamics
Information Technology (United States); P. G. Schunemann, K. Zawilski, BAE Systems (United
States); S. Guha, Air Force Research Lab. (United States)

7582 1B **Efficiency of a one-phonon Bragg anomalous light scattering in tellurium dioxide single
crystal with variously polarized incident light of visible range** [7582-45]
A. S. Shcherbakov, D. Sanchez Lucero, S. E. Balderas Mata, Instituto Nacional de Astrofísica,
Óptica y Electrónica (Mexico)

7582 1C **One- and two-photon pumped soft lithographed DFB laser systems based on
semiconductor core-shell quantum dots** [7582-46]
F. Todescato, I. Fortunati, S. Gardin, R. Signorini, R. Bozio, Univ. degli Studi di Padova (Italy);
J. J. Jasieniak, Commonwealth Scientific and Industrial Research Organisation (Australia);
A. Martucci, G. Della Giustina, G. Brusatin, M. Guglielmi, Univ. degli Studi di Padova (Italy)

POSTER SESSION

7582 1G **Practical aspects of applying triple correlations to the characterization of high-frequency
repetition trains of picosecond optical pulses** [7582-50]
A. S. Shcherbakov, P. Moreno Zarate, Instituto Nacional de Astrofísica, Óptica y Electrónica
(Mexico); J. Campos Acosta, CSIC-CETEF (Spain); S. Mansurova, Instituto Nacional de
Astrofísica, Óptica y Electrónica (Mexico); A. L. Muñoz Zurita, Autonomous Univ. of Coahuila
(Mexico); S. A. Némov, St. Petersburg State Polytechnical Univ. (Russian Federation)

7582 1H **Upconversion fluorescence spectroscopy in rare earth doped sol-gel nano-glass ceramics**
[7582-51]
L. A. Bueno, A. S. da Gouveia-Neto, A. F. da Silva, D. S. Moura, E. A. da Silva, E. B. Costa, Univ.
Federal Rural de Pernambuco (Brazil)

7582 1J **A high Brillouin amplification using liquid fluorocarbon** [7582-53]
F. F. Wu, A. Khizhnyak, V. Markov, MetroLaser, Inc. (United States)

- 7582 1L **Sellmeier and thermo-optic dispersion formulas for β -BaB₂O₄ (revisited)** [7582-55]
K. Kato, N. Umemura, Chitose Institute of Science and Technology (Japan); T. Mikami, Chitose Institute of Science and Technology (Japan) and Okamoto Optics Co., Ltd. (Japan)
- 7582 1M **UV supercontinuum excitation source generated by SPM and XPM in photonic crystal fibers** [7582-56]
R. R. Alfano, V. Kartazhev, I. Zeylikovich, The City College of New York (United States); D. Nolan, Corning Inc. (United States)
- 7582 1N **Accurate characterization of free carrier refraction in InP** [7582-57]
L. P. Gonzalez, Air Force Research Lab. (United States); S. Krishnamurthy, SRI International (United States); S. Guha, Air Force Research Lab. (United States)
- 7582 1O **1 W at 490 nm on a compact micro-optical bench by single-pass second harmonic generation** [7582-59]
C. Fiebig, G. Blume, D. Feise, D. Jedrzejczyk, A. Sahm, M. Uebernickel, K. Paschke, G. Erbert, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany)

Author Index

Conference Committee

Symposium Chairs

Donald J. Harter, IMRA America, Inc. (United States)
Peter R. Herman, University of Toronto (Canada)

Symposium Cochairs

Alberto Piqué, Naval Research Laboratory (United States)
Friedhelm Dorsch, TRUMPF Photonics (United States)

Conference Chair

Peter E. Powers, University of Dayton (United States)

Program Committee

Darrell J. Armstrong, Sandia National Laboratories (United States)
Pinhas Blau, Soreq Nuclear Research Center (Israel)
Majid Ebrahim-Zadeh, ICFO - Instituto de Ciencias Fotónicas (Spain)
Robert C. Eckardt, Consultant (United States)
Peter Günter, ETH Zürich (Switzerland)
Richard Hammond, U. S. Army Research Office (United States)
Angus J. Henderson, Lockheed Martin Aculight (United States)
Baldemar Ibarra-Escamilla, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico)
Yehoshua Y. Kalisky, Nuclear Research Center Negev (Israel)
Kenji Kitamura, National Institute for Materials Science (Japan)
Thomas J. Kulp, Sandia National Laboratories (United States)
Fredrik Laurell, Royal Institute of Technology (Sweden)
Yun-Shik Lee, Oregon State University (United States)
Rita D. Peterson, Air Force Research Laboratory (United States)
Kenneth L. Schepler, Air Force Research Laboratory (United States)
Peter G. Schunemann, BAE Systems (United States)
Andrei V. Shchegrov, Spectralus Corporation (United States)
Wei Shi, NP Photonics, Inc. (United States)
Ramesh K. Shori, Naval Air Warfare Center (United States)
Konstantin L. Vodopyanov, Stanford University (United States)

Session Chairs

- 1 Visible and UV Lasers: Joint Session with Conferences 7578 and 7580
Peter E. Powers, University of Dayton (United States)
Norman Hodgson, Coherent, Inc. (United States)
Dahv A. V. Kliner, JDSU (United States)
- 2 Visible Sources
Andrei V. Shchegrov, Spectralus Corporation (United States)
- 3 Ultrafast Nonlinear Devices and Applications I
Yehoshua Y. Kalisky, Nuclear Research Center Negev (Israel)
- 4 Optical Parametric Devices
Angus J. Henderson, Lockheed Martin Aculight (United States)
- 5 Nonlinear Optics for Spectroscopic Applications
Wei Shi, NP Photonics, Inc. (United States)
- 6 Nonlinear Fiber Devices and Applications
Peter E. Powers, University of Dayton (United States)
- 7 Terahertz Generation
Darrell J. Armstrong, Sandia National Laboratories (United States)
- 8 Engineered Nonlinear Optics
Konstantin L. Vodopyanov, Stanford University (United States)
- 9 Ultrafast Nonlinear Devices and Applications II
Baldemar Ibarra-Escamilla, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico)
- 10 Nonlinear Materials and Characterization
Pinhas Blau, Soreq Nuclear Research Center (Israel)