

PROCEEDINGS OF SPIE

Vertical External Cavity Surface Emitting Lasers (VECSELs) VII

Michael Jetter
Editor

30–31 January 2017
San Francisco, California, United States

Sponsored by
SPIE

Cosponsored by
Coherent, Inc. (United States)

Published by
SPIE

Volume 10087

Proceedings of SPIE 0277-786X, V. 10087

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

Vertical External Cavity Surface Emitting Lasers (VECSELs) VII, edited by Michael Jetter, Proc. of SPIE
Vol. 10087, 1008701 · © 2017 SPIE · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2276088

Proc. of SPIE Vol. 10087 1008701-1

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 *Vertical External Cavity Surface Emitting Lasers (VECSELs) VII*, edited by Michael Jetter, Proceedings of SPIE Vol. 10087 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510606159

ISBN: 9781510606166 (electronic)

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 © 2017, 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/17/\$18.00.

Printed in the United States of America.

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

**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. Papers are published as they are submitted and meet publication criteria. A unique 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 as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a seven-digit CID article numbering system in which:

- The first five 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.

Contents

- v *Authors*
vii *Conference Committee*

HIGH POWER CW / SINGLE FREQUENCY

- 10087 03 **Schemes for efficient QW pumping of AlGaInP disk lasers (Invited Paper)**
[10087-2]
- 10087 04 **Industrial integration of high coherence tunable single frequency semiconductor lasers based on VECSEL technology for scientific instrumentation in NIR and MIR (Invited Paper)**
[10087-3]
- 10087 05 **GaSb-based VECSEL for high-power applications and Ho-pumping (Invited Paper)**
[10087-4]

CHARACTERIZATION

- 10087 06 **Non-equilibrium effects in VECSELs (Invited Paper)** [10087-5]
- 10087 09 **Characterization of optically pumped semiconductor lasers in pulsed mode as a function of temperature** [10087-8]

NOVEL CONCEPTS I

- 10087 0A **Highly coherent modeless broadband VECSEL (Invited Paper)** [10087-9]
- 10087 0B **Multi-angle VECSEL cavities for dispersion control and multi-color operation (Invited Paper)**
[10087-10]
- 10087 0C **Low-noise III-V metasurface based semiconductor vortex laser and rotational Doppler velocimetry (Invited Paper)** [10087-11]

MODE LOCKING I

- 10087 0D **Commercial mode-locked vertical external cavity surface emitting lasers** [10087-12]
- 10087 0E **High power sub-200fs pulse generation from a colliding pulse modelocked VECSEL (Invited Paper)** [10087-13]

NOVEL CONCEPTS II

- 10087 0J **The optically pumped semiconductor membrane external-cavity surface-emitting laser (MECSEL): a concept based on a diamond-sandwiched active region (Invited Paper)** [10087-18]

MODE LOCKING II

- 10087 0M **Various phenomena of self-mode-locked operation in optically pumped semiconductor lasers (Invited Paper)** [10087-21]
- 10087 0O **Mode-locked VECSEL SESAM with intracavity antenna for terahertz emission (Best Student Paper Award)** [10087-23]

POSTER SESSION

- 10087 0Q **Numerical study of VECSELs for generation of mid-infrared radiation** [10087-25]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abdou Ahmed, Marwan, 03
Addamane, Sadvikas J., 0B
Adler, S., 05
Aidam, R., 05
Apostolopoulos, V., 0O
Bai, Yanbo, 09
Baker, Caleb, 0B
Balakrishnan, Ganesh, 0B
Beaudoin, Grégoire, 04, 0A, 0C
Bek, Roman, 03, 0J
Bialkowski, Bartłomiej, 0D
Brauch, Uwe, 03, 0J, 0R
Bronner, W., 05
Cerutti, Laurent, 04
Chen Sverre, T., 0O
Chen, Y. F., 0M
Chilla, Juan, 09
Chomet, Baptiste, 04, 0C
Denet, Stéphane, 04
Diwo-Emmer, E., 05
Ferrières, Laurence, 04
Fuhrberg, P., 05
Garnache, Arnaud, 04, 0A, 0C
Gow, P. C., 0O
Graf, Thomas, 03, 0J
Guina, Mircea, 0I
Hader, Jörg, 06, 0E
Head, C. Robin, 0D, 0O
Hempler, Nils, 0D
Holl, P., 05
Huang, K. F., 0M
Hyland, Patrick, 09
Jetter, Michael, 03, 0J
Jones, R. Jason, 0B
Kahle, Hermann, 03, 0J
Kilen, I., 06
Koch, Stephan W., 06, 0E
Lalanne, Philippe, 0C
Lamrini, S., 05
Laurain, Alexandre, 0B, 0E
Lecocq, Vincent, 04
Legratiet, Luc, 0C
Liang, H. C., 0M
Lin, Jipeng, 0D
Lubeigt, Walter, 0D
Lyytikäinen, Jari, 0I
Maker, Gareth T., 0D
Malcolm, Graeme P. A., 0D
Marah, Declan, 0E
Mateo, Cherry May N., 03, 0J
Mavrona, E., 0O
McInerney, John G., 0E
Michler, Peter, 03, 0J
Moloney, Jerome V., 06, 0B, 0E
Myara, Mikhaël, 04, 0A, 0C
Piskorski, Łukasz, 0Q
Rattunde, M., 05
Rockmore, Robert, 0E
Ruiz Perez, Antje, 0B, 0E
Sagnes, Isabelle, 04, 0A, 0C
Sarzała, Robert P., 0Q
Scheller, Maik, 0B
Scholle, K., 05
Scholz, Christian, 09
Seghillani, Mohamed, 0C
Sellahi, Mohamed, 0A, 0C
Sokół, Adam K., 0Q
Śpiewak, Patrycja, 0Q
Stolz, Wolfgang, 0B, 0E
Tropper, A. C., 0O
Tsou, C. H., 0M
Turnbull, A. P., 0O
Wagner, J., 05
Wisdom, Jeffrey, 09
Woods, J. R. C., 0O
Yang, Hwang-Jye, 0B

Conference Committee

Symposium Chairs

Reinhart Poprawe, Fraunhofer-Institut für Lasertechnik (Germany)
Koji Sugioka, RIKEN (Japan)

Symposium Co-chairs

Guido Hennig, Daetwyler Graphics AG (Switzerland)
Yongfeng Lu, University of Nebraska-Lincoln (United States)

Conference Chair

Michael Jetter, Universität Stuttgart (Germany)

Conference Program Committee

Juan L. Chilla, Coherent, Inc. (United States)
Arnaud Garnache, Université Montpellier (France)
Mircea Guina, Tampere University of Technology (Finland)
Jennifer E. Hastie, University of Strathclyde (United Kingdom)
Elyahou Kapon, Ecole Polytechnique Fédérale de Lausanne
(Switzerland)
Ursula Keller, ETH Zürich (Switzerland)
Jerome V. Moloney, College of Optical Sciences, The University of
Arizona (United States)
Wolfgang Stolz, NAsP III/V GmbH (Germany)
Anne C. Tropper, University of Southampton (United Kingdom)
Keith G. Wilcox, University of Dundee (United Kingdom)

Session Chairs

- 1 High Power cw / Single Frequency
Mircea Guina, Tampere University of Technology (Finland)
- 2 Characterization
Arnaud Garnache, Université Montpellier (France)
- 3 Novel Concepts I
Juan L. Chilla, Coherent, Inc. (United States)
- 4 Mode Locking I
Keith G. Wilcox, University of Dundee (United Kingdom)

- 5 Novel Gain Materials and Wavelength Conversion
Anne C. Tropper, University of Southampton (United Kingdom)
- 6 Novel Concepts II
Ursula Keller, ETH Zürich (Switzerland)
- 7 Mode Locking II
Alexandre Laurain, College of Optical Sciences, The University of
Arizona (United States)