PROCEEDINGS OF SPIE

Laser Resonators, Microresonators, and Beam Control XXI

Alexis V. Kudryashov Alan H. Paxton Vladimir S. Ilchenko Editors

4–7 February 2019 San Francisco, California, United States

Sponsored and Published by SPIE

Volume 10904

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigital Library.org.

The papers 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 these proceedings:

Author(s), "Title of Paper," in Laser Resonators, Microresonators, and Beam Control XXI, edited by Alexis V. Kudryashov, Alan H. Paxton, Vladimir S. Ilchenko. Proceedings of SPIE Vol. 10904 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510624504

ISBN: 9781510624511 (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 © 2019, 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/19/\$18.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

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



Paper Numbering: Proceedings of SPIE follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- 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.

Contents

∨ii ix	Authors Conference Committee
	MICRORESONATORS IN NOVEL DEVICES AND TOPOLOGIES I
10904 02	Experimental observation of above billion quality factor in silicon crystalline optical whispering gallery mode resonators [10904-1]
10904 03	Quasi-phase matching in integrated lithium-niobate whispering galleries (Invited Paper) [10904-2]
10904 06	Enhancing Raman lasers with single molecule monolayers (Invited Paper) [10904-5]
	MICRORESONATORS AND FREQUENCY COMBS I
10904 0C	Advances in quantum optical frequency combs [10904-10]
10904 0D	High repetition rate frequency comb up- and down-conversion in synchronously driven $x^{(2)}$ microresonators [10904-11]
10904 0G	Frequency comb generation in a quadratic nonlinear waveguide resonator [10904-14]
	MICRORESONATORS AND SOLITONS I
10904 OJ	Dual comb generation in a monochromatically driven crystalline microresonator [10904-17]
10904 OK	Spectrum collapse, narrow lines, and soliton combs with multi-frequency laser diodes locked to optical microresonators (Invited Paper) [10904-18]
	MICRORESONATORS AND SOLITONS II
10904 0M	Kerr comb generation in a mode coupled system (Invited Paper) [10904-20]
1090400	Multiplexing soliton-combs in optical microresonators [10904-22]
10904 OP	Dually-pumped Kerr microcombs for spectrally pure radio frequency signal generation and time-keeping [10904-23]

	MICRORESONATORS AND FREQUENCY COMBS II
10904 OS	Observation of novel optical and microwave power dependent effects in silicon micro-ring modulator based frequency comb generators [10904-26]
10904 OV	Numerical studies on Kerr comb generation in Si ₃ N ₄ resonators with frequency dependent access coupler properties $[10904-29]$
	MICRORESONATORS IN NOVEL DEVICES AND TOPOLOGIES II
10904 OZ	Three-dimensional organic microlasers [10904-33]
	QUANTUM OPTICS WITH MICRORESONATORS
10904 13	Photon-mediated interactions between quantum emitters in a diamond nanocavity (Invited Paper) [10904-37]
	MICRORESONATORS IN NOVEL DEVICES AND TOPOLOGIES III
10904 16	Cavity-ringdown-spectroscopy-based study of high Q resonators in add-drop configuration [10904-40]
10904 17	Passive and active whispering gallery mode microresonators in optical engineering (Invited Paper) [10904-41]
	MICRORESONATORS IN NOVEL DEVICES AND TOPOLOGIES IV
10904 1A	Characterization of the thermo-optic coefficient of silicon oxynitride using whispering gallery mode optical microcavities [10904-44]
109041C	Cross-polarization coupling of whispering-gallery modes due to the spin-orbit interaction of light [10904-46]
10904 1D	Enhanced absorption sensing using non-adiabatic tapered fiber coupling to a whispering-gallery microresonator [10904-47]

	BEAM SHAPING I
109041G	Beam shaping for ultrafast materials processing (Invited Paper) [10904-50]
109041H	High power laser mode conversion with volume phase elements recorded in PTR glass [10904-51]
10904 11	Focusing laser beam through pinhole using bimorph deformable mirror [10904-52]
	BEAM SHAPING II
10904 1K	Stacked-actuators deformable mirror vs bimorph mirror for laser beam shaping [10904-54]
10904 1L	Design and analysis of binary fan-out gratings based on step-transition perturbation approach [10904-55]
10904 1 M	Machine learning aided phase retrieval algorithm for beam splitting with an LCoS-SLM [10904-56]
	BEAM COMBINING, MODE CONTROL, BEAM DIAGNOSTICS
10904 1N	Kramers-Kronig self-phasing effect in passive beam combining resonators (Invited Paper) [10904-57]
10904 1P	Intracavity second harmonic generation for higher-order laser modes [10904-59]
10904 1R	Novel method to mitigate ghost images in laser beam diagnostic and laser vision systems (Invited Paper) [10904-62]
	POSTER SESSION
10904 1T	Numerical and experimental study of the dynamics of cross polarization coupling in a single whispering-gallery microresonator [10904-65]
10904 1U	Non-resonant operation of microcavity Brillouin lasers [10904-66]
10904 1V	Tapered hollow annular core fiber coupled whispering-gallery mode microsphere resonators [10904-67]
10904 1W	Sensing of multiple parameters with whispering gallery mode optical fiber micro-resonators [10904-68]

- 10904 1X **High power Nd:YVO-KGW conical refraction laser** [10904-69]
- Conical refraction lasing in a Nd:YVO₄ laser with a conerefringent KGW element [10904-71]