

Microfluidics, BioMEMS, and Medical Microsystems XV

Bonnie L. Gray
Holger Becker
Editors

28–30 January 2017
San Francisco, California, United States

Sponsored by
SPIE

Co-sponsored by
microfluidic ChipShop GmbH (Germany)
The Ohio Center for Microfluidic Innovation at the University of Cincinnati (United States)

Published by
SPIE

Volume 10061

Proceedings of SPIE, 1605-7422, V. 10061

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

Microfluidics, BioMEMS, and Medical Microsystems XV, edited by Bonnie L. Gray, Holger Becker, Proc. of SPIE Vol. 10061, 1006101 · © 2017 SPIE · CCC code: 1605-7422/17/\$18 · doi: 10.1117/12.2275886

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 SPIEDigitalLibrary.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 *Microfluidics, BioMEMS, and Medical Microsystems XV*, edited by Bonnie L. Gray, Holger Becker, Proceedings of SPIE Vol. 10061 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510605633

ISBN: 9781510605640 (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 1605-7422/17/\$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
SPIEDigitalLibrary.org

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

vii	<i>Authors</i>
ix	<i>Conference Committee</i>

SESSION 1	MANUFACTURING I
10061 02	Hybrid carbon nanotube-polymer scaffolds for cardiac tissue regeneration (Invited Paper) [10061-1]
10061 04	Rapid structuring of proteins on filter paper using lithography [10061-3]
10061 05	Graphene doped ZnO films for photoelectrowetting on microchannels [10061-4]
SESSION 2	MICROFLUIDIC DEVICES I
10061 08	Investigation of the capillary flow through open surface microfluidic structures [10061-8]
10061 0A	AC electrothermal technique in microchannels [10061-10]
SESSION 3	MANUFACTURING II
10061 0D	Fast and cheap fabrication of molding tools for polymer replication [10061-14]
SESSION 4	APPLICATIONS I
10061 0E	3D printed disposable optics and lab-on-a-chip devices for chemical sensing with cell phones (Invited Paper) [10061-15]
10061 0F	Implementation of a protocol for assembling DNA in a Teflon tube [10061-16]
10061 0H	Towards rapid prototyped convective microfluidic DNA amplification platform [10061-18]
SESSION 5	OPTOFLUIDICS I
10061 0I	System-level integration of active silicon photonic biosensors (Invited Paper) [10061-19]
10061 0J	Light field 3D endoscope based on electro-wetting lens array [10061-20]
10061 0L	An optofluidic approach for gold nanoprobe based-cancer theranostics [10061-22]

SESSION 6		OPTOFLUIDICS II
10061 0M	A portable fluorescent sensing system using multiple LEDs (Invited Paper) [10061-23]	
10061 0O	Chemiluminescence generation and detection in a capillary-driven microfluidic chip [10061-25]	
10061 0P	Multipath trapping dynamics of nanoparticles towards an integrated waveguide with a high index contrast [10061-26]	
SESSION 7		MICROFLUIDIC DEVICES II
10061 0S	Piezoelectric micromachined ultrasonic transducers and micropumps: from design to optomicrofluidic applications [10061-29]	
10061 0T	Optimized AC electrothermal micromixing design for biofluid systems [10061-30]	
SESSION 8		APPLICATIONS II
10061 0X	Microfluidic separation of particles from whole blood using shear induced diffusion [10061-34]	
10061 0Y	Controllable gas in oil in water double emulsion formation in a non-planar microfluidic device [10061-35]	
SESSION 9		APPLICATIONS III
10061 0Z	Peptide library synthesis on spectrally encoded beads for multiplexed protein/peptide bioassays (Invited Paper) [10061-36]	
10061 10	Microfluidic system for in-vitro hypoxia assays [10061-37]	
10061 11	Lab-on-a-chip platform for high throughput drug discovery with DNA-encoded chemical libraries [10061-38]	
10061 12	Thermally assisted acoustophoresis as a new stiffness-based separation method (Best Student Paper) [10061-39]	
SESSION 10		MEDICAL DEVICES
10061 13	Integration of systems biology with organs-on-chips to humanize therapeutic development (Invited Paper) [10061-40]	
10061 16	Microfluidic devices for stem-cell cultivation, differentiation and toxicity testing [10061-43]	

POSTER SESSION

- 10061 19 **Liquid-phase reduction synthesis of mono-dispersed gold nanoparticles on glass microfluidic device with flow rate control** [10061-44]
- 10061 1A **Numerical study of insulator-based dielectrophoresis method for circulating tumor cell separation** [10061-47]

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.

Aghaamoo, Mohammad, 1A	Kimerling, Lionel C., 0P
Aghilinejad, Arian, 1A	Kirschner, Nadine, 0D
Ahadian, Samad, 02	Klotzbach, U., 10, 11
Ajit, Smrithi, 0H	Knopf, George K., 05
Al-Arife, Khaled, 05	Koch, Katharina K. C., 0Y
Al'Mrayat, O., 0I	Kotz, Frederik, 04
Barnett, Jonathan Z., 0M	Kurtz, Andreas, 16
Baxter, Brian, 0Z	Lagae, Liesbet, 08
Becker, Holger, 16	Laplatine, L., 0I
Brower, Kara, 0Z	Lee, Jin Su, 0J
Busek, M., 10, 11	Li, Guifang, 0P
Chen, Wen Li Kelly, 13	Liang, Xiao, 0X
Chen, Xiaolin, 1A	Liang, Yitao, 0X
Cheung, K., 0I	Luan, E., 0I
Choi, Jin-Woo, 0M	Madzik, Mateusz T., 0S
Chrostowski, L., 0I	Michel, Jurgen, 0P
Cirit, Murat, 13	Mohan, K. N., 0H
Clark, Amanda M., 13	Mrowka, Ralf, 16
Comina, G., 0E	Nargang, Tobias M., 04
Cook, Peter R., 0F	Navi, Maryam, 0A, 0T
Cui, M., 11	Nguyen, Huy Q., 0Z
Dalton, Colin, 0A, 0T	Panwar, Nishtha, 0L
Dattner, Y., 0I	Papautsky, Ian, 0X
Dave, Abhishek, 0H	Praveen, Hemanth Mithun, 0H
Davenport-Huyer, Locke, 02	Radisic, Milica, 02
Delamarche, Emmanuel, 0O	Ramon, Charlotte, 0O
Dolatmoradi, Ata, 12	Rapp, Bastian E., 04, 0D
Edington, Collin D., 13	Ratner, D. M., 0I
El-Zahab, Bilal, 12	Reddavid, F. V., 11
Fang, C., 0I	Rezaieazadeh, S., 0I
Fang, Yifeng, 0X	Richter, Christiane, 0D
Feuerborn, Alexander, 0F	Rusch, Kelly A., 0M
Filippini, D., 0E	S. B., Puneeth, 0H
Fiorini, Paolo, 08	Saeed, Numan, 0S
Fordyce, Polly M., 0Z	Salari, Alinaghi, 0A, 0T
Gärtner, Claudia, 16	Schmieder, F., 10
Goel, Sanket, 0H	Sesham, Bharat, 0H
Griffith, Linda G., 13	Shin, Young-Ho, 0M
Grünzner, S., 10, 11	Smith, Nathaniel, 02
Gutierrez-Wing, M. Teresa, 0M	Song, Peiyi, 0L
Hansen-Hagge, Thomas, 16	Sonntag, F., 10, 11
Harink, Björn, 0Z	Steege, T., 10
Helmer, Dorothea, 04	Steinfelder, C., 10, 11
Huang, Bobo, 0X	Suska, A., 0E
Huang, Cong, 0Y	Taha, Inas, 0S
Jones, Benjamin, 08	Taher, Ahmed, 08
Jung, Gyu Suk, 0J	Tanabe, Yu, 19
Keller, Nico, 04	Temiz, Yuksel, 0O
Khazaaleh, Shadi, 0S	Thorn, Kurt S., 0Z

Tian, Hao, 0P
Tjin, Swee Chuan, 0L
Trumper, David L., 13
Tu, Chunlong, 0X
Viegas, Jaime, 0S
Walsh, Edmond J., 0F
Wells, Alan, 13
Wölfl, Stefan, 16
Won, Yong Hyub, 0J
Worgull, Matthias, 0D
Yagyu, Hiromasa, 19
Yang, Chengbin, 0L
Ye, Xuesong, 0X
Yin, Rui-Xue, 0Y
Yong, Ken-Tye, 0L
Zhang, Hong-Bo, 0Y
Zhang, Lin, 0P
Zhang, Wen-Jun, 0Y
Zhang, Y., 11
Zhou, Jian, 0X

Conference Committee

Symposium Chairs

James G. Fujimoto, Massachusetts Institute of Technology
(United States)

R. Rox Anderson, Wellman Center for Photomedicine, Massachusetts
General Hospital (United States) and Harvard School of Medicine
(United States)

Program Track Chairs

Tuan Vo Dinh, Fitzpatrick Institute for Photonics, Duke University
(United States)

Anita Mahadevan-Jansen, Vanderbilt University (United States)

Conference Chairs

Bonnie L. Gray, Simon Fraser University (Canada)

Holger Becker, microfluidic ChipShop GmbH (Germany)

Conference Program Committee

Brian W. Anthony, Massachusetts Institute of Technology
(United States)

Yolanda Fintschenko, LabSmith, Inc. (United States)

Bruce K. Gale, The University of Utah (United States)

Albert K. Henning, Aquarian Microsystems (United States)

Yu-Cheng Lin, National Cheng Kung University (Taiwan)

Yuehe Lin, Pacific Northwest National Laboratory (United States)

Ciara K. O'Sullivan, Universitat Rovira i Virgili (Spain)

Ian Papautsky, University of Cincinnati (United States)

Bastian E. Rapp, Karlsruher Institut für Technologie (Germany)

Thomas Stieglitz, Albert-Ludwigs-Universität Freiburg (Germany)

Sindy Kam-Yan Tang, Stanford University (United States)

Albert van den Berg, MESA+ Institute for Nanotechnology
(Netherlands)

Wanjun Wang, Louisiana State University (United States)

Bernhard H. Weigl, PATH (United States)

Session Chairs

- 1 Manufacturing I
Bonnie L. Gray, Simon Fraser University (Canada)
Holger Becker, microfluidic ChipShop GmbH (Germany)
- 2 Microfluidic Devices I
Bonnie L. Gray, Simon Fraser University (Canada)
- 3 Manufacturing II
Samad Ahadian, University of Toronto (Canada)
- 4 Applications I
Jin Woo Choi, Louisiana State University (United States)
- 5 Optofluidics I
Daniel Filippini, Linköping University (Sweden)
- 6 Optofluidics II
Loic Laplatine, The University of British Columbia (Canada)
- 7 Microfluidic Devices II
Jian Zhou, Zhejiang University (China)
- 8 Applications II
Polly Fordyce, Stanford University (United States)
- 9 Applications III
Somin Eunice Lee, University of Michigan (United States)
- 10 Medical Devices
Bonnie L. Gray, Simon Fraser University (Canada)
Holger Becker, microfluidic ChipShop GmbH (Germany)