# Optogenetics and Optical Manipulation

Samarendra K. Mohanty Nitish V. Thakor E. Duco Jansen Editors

28–29 January 2017 San Francisco, California, United States

Sponsored and Published by SPIE

**Volume 10052** 

Proceedings of SPIE, 1605-7422, V. 10052

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

Optogenetics and Optical Manipulation, edited by Samarendra K. Mohanty, Nitish V. Thakor, E. Duco Jansen, Proc. of SPIE Vol. 10052, 1005201 ⋅ © 2017 SPIE ⋅ CCC code: 1605-7422/17/\$18 ⋅ doi: 10.1117/12.2270047

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 these proceedings:

Author(s), "Title of Paper," in *Optogenetics and Optical Manipulation*, edited by Samarendra K. Mohanty, Nitish V. Thakor, E. Duco Jansen, Proceedings of SPIE Vol. 10052 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510605459

ISBN: 9781510605466 (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.



**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 vii	Authors Conference Committee
	DETECTION I
10052 02	Super-duper chemiluminescent proteins applicable to wide range of bioimaging (Keynote Paper) [10052-1]
10052 04	Using stereotactic brain atlases for small rodents and nonhuman primates for optrode array customization [10052-3]
	DETECTION II
10052 07	Micro-device combining electrophysiology and optical imaging for functional brain monitoring in freely moving animals [10052-6]
	STIMULATION II
10052 0G	3D Monte Carlo model with direct photon flux recording for optimal optogenetic light delivery [10052-15]
	STIMULATION III
10052 OJ	Short infrared laser pulses block action potentials in neurons [10052-17]
10052 OK	Active implant for optoacoustic natural sound enhancement [10052-18]
	APPLICATION
10052 0Q	Multi-characteristic opsin enabled vision restoration [10052-24]

### **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.

Beier, Hope T., 0J Bhattacharya, Sulagna, OQ Blair, Steve, 04 Boutte, Ronald W., 04 Burch, T., OK Dalv. A., 0K Fretz, M., 0K Gajjeraman, Sivakumar, 0Q Garnham, C., 0K Griffiths, Brandon, 04 lbey, Bennett L., OJ Jose James, R., OK Kim, Dongmok, 0G Kral, A., OK Kwon, Hyuk-Sang, 0G Lee, Jihoon, 0G Li, Miao, 07 Mahapatra, Vasu, 0Q Martens, Stacey L., OJ Merlin, Sam, 04 Miao, Peng, 07 Milani, R., 0K Mohanty, Samarendra, 0Q Mohrdiek, S., OK Nagai, Takeharu, 02 Noell, W., 0K Ortsiefer, M., 0K Parry, Trent, 04 Pradhan, Sanjay, OQ Putkonen, M., 0K Rettenmaier, A., 0K Shah, D., 0K Shin, Younghoon, 0G Spinola Durante, G., 0K Suzuki, Kazushi, 02 Thakor, Nitish V., 07 Tolstykh, Gleb P., 0J Tripathy, Ashutosh, 0Q Vinciguerra, V., 0K Walsh, Alex J., 0J

Wang, Qihong, 07 Wright, Weldon, 0Q Zhang, Lingke, 07

## **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:

Rafael Yuste, Columbia University (United States)

David Boas, Massachusetts General Hospital, Harvard Medical School
(United States)

#### Conference Chairs

**Samarendra K. Mohanty**, Nanoscope Technologies, LLC (United States)

**Nitish V. Thakor**, Johns Hopkins University (United States) and National University of Singapore (Singapore)

E. Duco Jansen, Vanderbilt University (United States)

#### Conference Program Committee

Antoine Adamantidis, McGill University (Canada)

**George J. Augustine**, Duke-NUS Graduate Medical School (Singapore)

Klaus B. Gerwert, Ruhr-Universität Bochum (Germany)

**Xue Han**, Boston University (United States)

Elizabeth M. Hillman, Columbia University (United States)

Richard Kramer, University of California, Berkeley (United States)

Alfred L. Nuttall, Oregon Health & Science University (United States)

**Anna W. Roe**, Vanderbilt University (United States)

**Ulrich T. Schwarz**, Technische Universität Chemnitz (Germany)

**Shy Shoham**, Technion-Israel Institute of Technology (Israel)

**John P. Welsh**, University of Washington (United States)

Rafael Yuste, Columbia University (United States)

#### Session Chairs

Detection I

**Samarendra K. Mohanty**, Nanoscope Technologies, LLC (United States)

- 2 Detection II
  - **E. Duco Jansen**, Vanderbilt University (United States)
- 3 Stimulation I

**Nitish V. Thakor**, Johns Hopkins University (United States) and National University of Singapore (Singapore)

4 Stimulation II

**Shy Shoham**, Technion-Israel Institute of Technology (Israel)

5 Stimulation III

**Samarendra K. Mohanty**, Nanoscope Technologies, LLC (United States)

6 Stimulation IV

**Nitish V. Thakor**, Johns Hopkins University (United States) and National University of Singapore (Singapore)

7 Keynote

**Samarendra K. Mohanty**, Nanoscope Technologies, LLC (United States)

**Nitish V. Thakor**, Johns Hopkins University (United States) and National University of Singapore (Singapore)

- 8 Application
  - **E. Duco Jansen**, Vanderbilt University (United States)