Front Matter: Volume 6441
Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues V

Daniel L. Farkas
Robert C. Leif
Dan V. Nicolau
Editors

22–24 January 2007
San Jose, California, USA

Sponsored and Published by
SPIE—The International Society for Optical Engineering
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:


ISSN 1605-7422
ISBN 9780819465542

Published by
SPIE—The International Society for Optical Engineering
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time)· Fax 1 360/647-1445
http://www.spie.org

Copyright © 2007, The 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 http://www.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 1605-7422/07/$18.00.

Printed in the United States of America.
Contents

xi  Conference Committee

SESSION 1  TISSUE AND CELLULAR IMAGING I

644102  Ionic contrast terahertz near-field imaging of axonal activity and water fluxes [6441-01]

644103  Visible hyperspectral imaging evaluating the cutaneous response to ultraviolet radiation
[6441-02]
M. A. Ilias, E. Häggblad, C. Anderson, E. G. Salerud, Linköping Univ. (Sweden)

644105  Multimode optical imaging of small animals: development and applications [6441-04]
J. Y. Hwang, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA); C. Moffatt-Blue, O. Equils, M. Fujita, Cedars-Sinai Medical Ctr. (USA); J. Jeong, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA); N. M. Khazenzon, E. Lindsley, J. Ljubimova, Cedars-Sinai Medical Ctr. (USA); A. G. Nowatzky, D. L. Farkas, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA); S. Wachsmann-Hogiu, Cedars-Sinai Medical Ctr. (USA)

644106  Radiofrequency time-domain EPR imaging: instrumentation development and recent results in functional physiological imaging [6441-05]
S. Subramanian, N. Devasahayam, M. C. Krishna, Ctr. for Cancer Research, National Cancer Institute (USA)

644108  Raman spectroscopy and Raman chemical imaging of apoptotic cells [6441-07]
J. L. Panza, J. S. Maier, ChemImage (USA)

644109  Examining cardiomyocyte development with spectral domain phase microscopy [6441-08]
A. K. Ellerbee, Duke Univ. (USA); T. L. Creazzo, Neonatal Perinatal Institute, Duke Univ. (USA); J. A. Izatt, Duke Univ. (USA)

Pagination: 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.
SESSION 2 TISSUE AND CELLULAR IMAGING II

64410A Hyperspectral imaging and spectral unmixing of stained tissue sections using a spectrally programmable light engine [6441-09]
N. B. MacKinnon, M. Khajasteh, P. M. Lane, C. E. MacAulay, M. Guillaud, British Columbia Cancer Agency (Canada); U. Stange, OneLight Corp. (Canada)

64410B Protein profile study of Pap smear and tissue of cervix by high performance liquid chromatography: laser induced fluorescence [6441-10]
N. Sujatha, Ctr. for Laser Spectroscopy, MAHE Life Sciences Ctr. (India); L. Rai, P. Kumar, B. R. Krishnanand, Kasturba Medical College, MAHE, Manipal (India); K. K. Mahato, S. D. George, V. B. Kartha, S. C, Ctr. for Laser Spectroscopy, MAHE Life Sciences Ctr. (India)

SESSION 3 CYTOMICS I

64410C Confocal time-resolved fluorescence anisotropy imaging (Invited Paper) [6441-11]
A. N. Bader, E. G. Hofman, P. van Bergen en Henegouwen, H. C. Gerritsen, Utrecht Univ. (Netherlands)

64410D TIRET microscopy: monitoring protein (amyloid precursor protein and beta-secretase) interaction on the surface of living cells [6441-12]
C. von Arnim, Univ. Ulm (Germany); M. Wagner, P. Weber, H. Schneckenburger, Institut für Angew. Hochschule Aalen (Germany)

64410E Epidermal growth factor signaling studied using multidimensional single molecule fluorescence microscopy [6441-13]

64410G Ultra-short pulses to signal neuronal growth cone machinery [6441-15]
M. Mathew, I. Amat-Roldan, Institut de Ciències Fotòniques (Spain); R. Andres, Parc Cientific de Barcelona (Spain); I. G. Cormack, Institut de Ciències Fotòniques (Spain); D. Artigas, Univ. Politècnica de Catalunya (Spain); E. Soriano, Parc Cientific de Barcelona (Spain); P. Loza-Alvarez, Institut de Ciències Fotòniques (Spain)

64410H Quantitative tissue cytometry (Tissomics): multimodal slide-based cytometry, confocal imaging, and volume rendering is the key (Invited Paper) [6441-16]
A. Tarnok, A. Mittag, J. Kuska, U.-D. Brammann, B. Mosch, T. Arendt, Univ. Leipzig (Germany)

64410I In vivo imaging flow cytometer [6441-17]
C. Alt, Wellman Ctr. for Photomedicine (USA) and Tufts Univ. (USA); H. Lee, Wellman Ctr. for Photomedicine (USA) and Kyongpook National Univ. (South Korea); C. Pitsillides, Wellman Ctr. for Photomedicine (USA) and Boston Univ. (USA); M. Puoris’haag, C. P. Lin, Wellman Ctr. for Photomedicine (USA)

64410J In vivo quantification of autofluorescence dynamics during renal ischemia and reperfusion under dual-UV excitation [6441-18]
R. N. Raman, Univ. of California, Davis (USA); C. D. Pivetti, Univ. of California, Davis Medical Ctr. (USA); D. L. Matthews, Univ. of California, Davis (USA); C. Troppmann, Univ. of California, Davis Medical Ctr. (USA); S. G. Demos, Lawrence Livermore National Lab. (USA) and Univ. of California, Davis Medical Ctr. (USA)
**SESSION 4**  CYTOMICS II

**64410N** Comparison of multidimensional flow cytometric data by a novel data mining technique [6441-21]
J. F. Leary, Purdue Univ. (USA), Bindley Biosciences Ctr., Purdue Univ. (USA), and Birck Nanotechnology Ctr., Purdue Univ. (USA); J. Smith, Texas A&M Univ. (USA); P. Szaniszlo, Univ. of Texas Medical Branch (USA); L. M. Reece, Purdue Univ. (USA)

**64410O** Automated classification and recognition of bacterial particles in flow by multi-angle scatter measurement and a support-vector machine classifier [6441-22]
B. Rajwa, Bindley Bioscience Ctr., Purdue Univ. (USA); M. Venkatapathi, Bindley Bioscience Ctr., Purdue Univ. (USA) and Purdue Univ. (USA); K. Ragheb, Bindley Bioscience Ctr., Purdue Univ. (USA); P. P. Banada, E. D. Hirleman, Purdue Univ. (USA); T. Lary, Cellular Analysis Technology Ctr., Beckman Coulter, Inc. (USA); J. P. Robinson, Bindley Bioscience Ctr., Purdue Univ. (USA)

**64410P** CytometryML: a data standard which has been designed to interface with other standards [6441-23]
R. C. Leif, XML_Med (USA)

**64410Q** A system and methodology for high-content visual screening of individual intact living cells in suspension [6441-24]
O. Renaud, Institut Pasteur (France); R. Heintzmann, King’s College London (United Kingdom); A. Sáez-Cirión, Institut Pasteur (France); T. Schnelle, T. Mueller, Evotec Technologies GmbH (Germany); S. Shorte, Institut Pasteur (France)

**64410R** Real-time quantitative fluorescence measurement of microscale cell culture analog systems [6441-25]
T. Oh, D. Kim, Yonsei Univ. (South Korea); D. Tatosian, J. H. Sung, M. Shuler, Cornell Univ. (USA)
### SESSION 5 MICROSCALE DEVICES AND MICROARRAYS I

**64410S** Biological applications of an LCoS-based programmable array microscope (PAM) (Invited Paper) [6441-26]

G. M. Hagen, Max Planck Institute for Biophysical Chemistry (Germany); W. Caarls, Delft Univ. of Technology (Netherlands); M. Thomas, A. Hill, Cairn Research Ltd. (United Kingdom); K. A. Lidke, Univ. of New Mexico (USA); B. Rieger, Delft Univ. of Technology (Netherlands); C. Fritsch, Univ. of Sussex (United Kingdom); B. van Geest, Lambert Instruments (Netherlands); T. M. Jovin, D. J. Arndt-Jovin, Max Planck Institute for Biophysical Chemistry (Germany)

**64410V** Development of an optical biochip for the analysis of cell environment sensitivity [6441-29]

D. Morris, Univ. of Wales, Bangor (United Kingdom); A. Goater, Univ. of Wales, Bangor (United Kingdom) and UK Laser Micromachining Ctr. (United Kingdom); A. Menachery, J. Burt, Univ. of Wales, Bangor (United Kingdom); N. Rizvi, UK Laser Micromachining Ctr. (United Kingdom); D. Matthews, H. Summers, Cardiff Univ. (United Kingdom); I. Pope, B. Vojnovic, Gray Cancer Institute, Univ. of Oxford (United Kingdom); K. Njoh, S. Chappell, R. Errington, P. Smith, Cardiff Univ. (United Kingdom)

### SESSION 6 MICROSCALE DEVICES AND MICROARRAYS II

**64410X** Live cell tracking on an optical biochip platform (Invited Paper) [6441-31]

K. Njoh, P. J. Smith, S. C. Chappell, School of Medicine, Cardiff Univ. (United Kingdom); H. D. Summers, D. Matthews, Cardiff Univ. (United Kingdom); D. Morris, A. Goater, J. Burt, Univ. of Wales (United Kingdom); I. Pope, B. Vojnovic, Gray Cancer Institute, Univ. of Oxford (United Kingdom); S. Ameer-Beg, King’s College London (United Kingdom); R. J. Errington, School of Medicine, Cardiff Univ. (United Kingdom)

**64410Y** Semiconductor light-emitting devices with in-built bioreaction chambers [6441-32]

H. D. Summers, D. R. Matthews, R. J. Errington, K. L. Njoh, P. J. Smith, Cardiff Univ. (United Kingdom); A. D. Goater, J. P. H. Burt, N. H. Rizvi, A. Menachery, D. J. Morris, Univ. of Wales, Bangor (United Kingdom)

**64410Z** Precise microinjection into living cells by summation of fluorescence intensity [6441-33]

K. Taninaka, A. Yabuki, Fujitsu Labs., Ltd. (Japan); A. Ito, T. Harada, Fujitsu Ltd. (Japan)

### SESSION 7 OPTICAL MANIPULATION

**644110** Single-SLM 3D interactive micromanipulation based on the generalized phase contrast (GPC) approach [6441-34]

P. J. Rodrigo, I. R. Perch-Nielsen, C. A. Alonzo, J. Glückstad, Risø National Lab. (Denmark)

**644111** Rotational behavior of erythrocytes in optical trap: revisited by confocal fluorescence microscopy [6441-35]

K. Mohanty, Univ. of California, Irvine (USA); S. Mohanty, Indian Institute of Science (India); S. Monajembashi, K. O. Greulich, Fritz Lipmann Institute (Germany)

**644112** Development and applications of an optical tweezer-based microrheometer: case studies of biomaterials and living cells [6441-36]

J. Wang, H. Yalcin, A. Lengel, C. Hewitt, H. D. Ou-Yang, Lehigh Univ. (USA)
A high-resolution optofluidic microscope with optical tweezer actuation [6441-37]
X. Heng, E. Hsiao, California Institute of Technology (USA); D. Psaltis, California Institute of Technology (USA) and Ecole Polytechnique Federale de Lausanne (Switzerland); C. Yang, California Institute of Technology (USA)

Optical tweezers force calibration using a fast shuttering camera [6441-38]
J. P. Sharpe, Cal Poly State Univ. (USA); C. Iniguez-Palomares, Ctr. de Investigación en Alimentación y Desarrollo (Mexico); R. Jimenez-Flores, Cal Poly State Univ. (USA)

On chip optical tweezers for large scale trapping of microparticles [6441-39]
Y. Sun, X. Yuan, L. S. Ong, J. Bu, Nanyang Technological Univ. (Singapore)

Single fiber optical tweezers for manipulation of microscopic objects [6441-40]
S. Mohanty, Beckman Laser Institute (USA); K. Mohanty, Univ. of California, Irvine (USA)

SESSION 8 ADVANCES IN BIOIMAGING I

HiFLO: a high-throughput system for spatial analysis of FISH loci in interphase nuclei [6441-43]
P. R. Gudla, J. Collins, NCI/SAIC-Frederick (USA); K. J. Meaburn, T. Misteli, NCI (USA); S. J. Lockett, NCI/SAIC-Frederick (USA)

Wide-field two-photon microscopy: features and advantages for biomedical applications [6441-45]
S. Wachsmann-Hogiu, Cedars-Sinai Medical Ctr. (USA); J. Y. Hwang, Cedars-Sinai Medical Ctr. (USA) and Univ. of Southern California (USA); E. Lindsley, Cedars-Sinai Medical Ctr. (USA); D. L. Farkas, Cedars-Sinai Medical Ctr. (USA) and Univ. of Southern California (USA)

A biomimetic algorithm for the improved detection of microarray features [6441-70]
D. V. Nicolau, Jr., Univ. of Oxford (United Kingdom); D. V. Nicolau, Liverpool Univ. (United Kingdom); P. K. Maini, Univ. of Oxford (United Kingdom)

Living organism imaging with the adaptive scanning optical microscope (ASOM) [6441-47]
B. Potsaid, F. P. Finger, J. T. Wen, Rensselaer Polytechnic Institute (USA)

Axially resolved cell imaging by intensity modulated total internal reflection fluorescence microscopy (IM-TIRFM) [6441-48]
H. Schneckenburger, Institut für Angewandte Forschung, Hochschule Aalen (Germany) and Institut für Lasertechnologien in der Medizin und Messtechnik, Univ. Ulm (Germany); H. Baumann, M. Wagner, Institut für Angewandte Forschung, Hochschule Aalen (Germany); W. S. L. Strauss, Institut für Lasertechnologien in der Medizin und Messtechnik, Univ. Ulm (Germany)

On-chip differential interference contrast (DIC) phase imager and beam profiler based on Young's interference [6441-49]
X. Cui, M. Lew, X. Heng, C. Yang, California Institute of Technology (USA)

SESSION 9 ADVANCES IN BIOIMAGING II

Time-gated confocal Raman microscopy: system design and its applications [6441-51]
V. V. Yakovlev, Univ. of Wisconsin, Milwaukee (USA)
Contrast enhancement in biomedical optical imaging using ultrabright color LEDs [6441-52]
K. Burton, R. Zelikowsky, D. Shandling, E. Lindsley, D. L. Farkas, Cedars-Sinai Medical Ctr.
(USA)

Development of automatic image analysis algorithms for protein localization studies in budding yeast [6441-53]
K. Logg, Chalmers Univ. of Technology (Sweden); M. Kvarnström, Chalmers Univ. of Technology (Sweden) and Fraunhofer-Chalmers Research Ctr. (Sweden); A. Diez, K. Bodvard, M. Käll, Chalmers Univ. of Technology (Sweden)

Development of a hyperspectral fluorescence lifetime imaging microscope and its application to tissue imaging [6441-54]

Quantitative orientation-independent differential interference contrast (DIC) microscopy [6441-55]
M. Shribak, Marine Biological Lab. (USA); J. LaFountain, Univ. at Buffalo (USA); D. Biggs, AutoQuant Imaging Inc. (USA); S. Inoué, Marine Biological Lab. (USA)

Gamma-H2AX foci counting: image processing and control software for high-content screening [6441-56]
P. R. Barber, R. J. Locke, G. P. Pierce, K. Rothkamm, B. Vojnovic, Gray Cancer Institute, Univ. of Oxford (United Kingdom)

Intelligent spectral signature bio-imaging in vivo for surgical applications [6441-57]
J. Jeong, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA); P. K. Frykman, M. Gaon, A. P. Chung, E. H. Lindsley, Cedars-Sinai Medical Ctr. (USA); J. Y. Hwang, D. L. Farkas, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA)

Aberrated optical tweezers for manipulation of microscopic objects [6441-58]
S. K. Mohanty, P. K. Gupta, Raja Ramanna Ctr. for Advanced Technology (India)

POSTER SESSION

Development of near-infrared fluorescent probes for nitric oxide and zinc ion [6441-59]
H. Kojima, K. Kiyose, Univ. of Tokyo (Japan) and CREST, JST (Japan); E. Sasaki, Univ. of Tokyo (Japan); H. Nishimatsu, Y. Hirata, T. Nagano, Univ. of Tokyo (Japan) and CREST, JST (Japan)

Spatial difference in pH in Lucilia cuprina (Diptera: Calliphoridae) pericardial cells [6441-61]
O. Lilje, E. S. Lilje, Univ. of Sydney (Australia)

Leishmania amazonensis chemotaxis under glucose gradient studied by the strength and directionality of forces measured with optical tweezers [6441-62]
L. de Ysasa Pozzo, A. Fontes, A. A. de Thomaz, L. C. Barbosa, Instituto de Fisica Gleb Wataghin, UNICAMP (Brazil); D. C. Ayres, S. Giorgio, Instituto de Biologia, UNICAMP (Brazil); C. L. Cesar, Instituto de Fisica Gleb Wataghin, UNICAMP (Brazil)
Iron oxide nanoparticles as drug delivery agents in MIA PaCa-2 pancreatic cells [6441-64]
Oakwood College (USA)

Experimental study of various effects on backward SHG in biotissue [6441-65]
N. Liu, Y. Qiu, X. Zhang, Fujian Normal Univ. (China)

Changes of delayed luminescence and CLSM imaging of chlorophyll autofluorescence
during petal development in Gerbera hybrida [6441-68]
W. L. Chen, Institute of Laser Life Science, South China Normal Univ., and College of Life
Science, South China Normal Univ. (China); Y. Bi, College of Life Science, South China
Normal Univ. (China); Q. Li, Institute of Laser Life Science, South China Normal Univ. (China);
Q. Zhou, Institute of Laser Life Science, South China Normal Univ. (China) and Medical
Imaging Ctr., Jinan Univ. (China); D. Xing, Institute of Laser Life Science, South China
Normal Univ. (China)

Optical detection of sepsis markers using liquid crystal based biosensors (Invited Paper)
[6441-69]
M. K. McCamley, Brown Univ. (USA); A. W. Artenstein, S. M. Opal, Memorial Hospital (USA);
G. P. Crawford, Brown Univ. (USA)

Author Index
Conference Committee

Symposium Chairs

James G. Fujimoto, Massachusetts Institute of Technology (USA)
R. Rox Anderson, Wellman Center for Photomedicine, Massachusetts General Hospital, and Harvard School of Medicine (USA)

Program Track Chairs

Ammasi Periasamy, University of Virginia (USA)
Daniel L. Farkas, Cedars-Sinai Medical Center (USA)

Conference Chairs

Daniel L. Farkas, Cedars-Sinai Medical Center (USA)
Robert C. Leif, Newport Instruments (USA)
Dan V. Nicolau, The University of Liverpool (United Kingdom)

Conference Cochair

J. Paul Robinson, Purdue University (USA)
Attila Tarnok, University Leipzig (Germany)
Ramesh Raghavachari, U.S. Food and Drug Administration (USA)

Program Committee

Christopher H. Contag, Stanford University (USA)
Paul Dan A. Cristea, Universitatea Politehnica Bucharest (Romania)
Alberto Diaspro, Università degli Studi di Genova (Italy)
Erik G. Fällman, Umeå University (Sweden)
Jesper Glückstad, Risø National Laboratory (Denmark)
Ewa M. Goldys, Macquarie University (Australia)
James F. Leary, Purdue University (USA)
Charles P. Lin, Massachusetts General Hospital (USA)
Andreas Nowatzyk, Cedars-Sinai Medical Center (USA)
Markus Sauer, Institut für Neue Materialien GmbH (Germany)

Session Chairs

1. Tissue and Cellular Imaging I
   Daniel L. Farkas, Cedars-Sinai Medical Center (USA)

2. Tissue and Cellular Imaging II
   Daniel L. Farkas, Cedars-Sinai Medical Center (USA)
3 Cytomics I  
Robert C. Leif, Newport Instruments (USA)

4 Cytomics II  
Attila Tarnok, University Leipzig (Germany)

5 Microscale Devices and Microarrays I  
James F. Leary, Purdue University (USA)

6 Microscale Devices and Microarrays II  
Dan V. Nicolau, The University of Liverpool (United Kingdom)

7 Optical Manipulation  
Dan V. Nicolau, The University of Liverpool (United Kingdom)

8 Advances in Bioimaging I  
J. Paul Robinson, Purdue University (USA)  
Attila Tarnok, University Leipzig (Germany)

9 Advances in Bioimaging II  
Sebastian Wachsmann-Hogiu, Cedars-Sinai Medical Center (USA)