Oeabt 基座光学
Optics Experiment and Basic Teaching
Oeabt Optics Technology

激光篇 基座光学专业文集

(内容来自网络,由基座光学搜集整理,仅供学习交流使用)

细胞生物学中的激光成像和操控

Laser Imaging and Manipulation in Cell Biology

Edited by
Francesco S. Pavone

Laser Imaging and Manipulation in Cell Biology

版权免责声明

本文集内容均来源于网络，版权归著作方所有。广州基座光学科技有限公司仅做搜集整理工作，并供读者学习参考用途。在使用本文集内容时可能造成实际或预期的损失，读者转载时破坏电子文档的完整性，或以商业盈利目的复制和销售等行为，本公司概不承担任何责任。若原文版权方有异议，请联系我们删除。

Related Titles

Yu, S. F.

Analysis and Design of Vertical Cavity Surface Emitting Lasers

464 pages

2008

E-Book

ISBN: 978-0-470-34999-1

Lasch, P., Kneipp, J.

Biomedical Vibrational Spectroscopy

400 pages

2008

E-Book

ISBN: 978-0-470-28316-5

Mix, P. E.

Introduction to Nondestructive Testing

A Training Guide

682 pages

2008

E-Book

ISBN: 978-0-470-35329-5

Ersoy, O. K.

Diffraction, Fourier Optics and Imaging

414 pages

2006

Hardcover

ISBN: 978-0-471-23816-4

Lanzani, G. (ed.)

Photophysics of Molecular Materials

From Single Molecules to Single Crystals

600 pages with 302 figures and 16 tables

2006

Hardcover

ISBN: 978-3-527-40456-8

Durack, G., Robinson, J. P. (eds.)

Emerging Tools for Single-Cell Analysis

Advances in Optical Measurement Technologies

2004

E-Book

ISBN: 978-0-471-46100-5

Edited by
Francesco S. Pavone

Laser Imaging and Manipulation in Cell Biology

WILEY-VCH Verlag GmbH & Co. KGaA

The Editor

Dr. Francesco S. Pavone
European Laboratory for Non Linear Spectroscopy (LENS)
Polo Scientifico
Sesto Fiorentino, Italy
francesco.pavone@unifi.it

Cover
Two-photon imaging of hippocampal pyramidal neurons (YFP labelled).

Library of Congress Card No.: applied for

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at http://dnb.d-nb.de.

Cover Design Grafik-Design Schulz, Fußgönheim
Typesetting Thomson Digital, Noida, India
Printing and Binding Fabulous Printers Pte Ltd

Printed in Singapore
Printed on acid-free paper

ISBN: 978-3-527-40929-7

Contents

List of Contributors *XI*

Introduction *1*
Francesco S. Pavone

Part One Multiphoton Imaging and Nanoprocessing *7*

1 Multiphoton Imaging and Nanoprocessing of Human Stem Cells *9*
Karsten König and Aisada Uchugonova
1.1 Introduction *9*
1.2 Principle of Two-Photon Microscopy and Multiphoton Tomography *10*
1.3 Multiphoton Microscopes and Multiphoton Tomographs *12*
1.4 Endogenous Cellular Fluorophores and SHG Active Biomolecule Structures *14*
1.5 Optical Nanoprocessing *17*
1.5.1 Principle and Mechanism of Femtosecond Laser Nanoprocessing *17*
1.5.2 Stem Cells *18*
1.5.3 Upgrading the Multiphoton Microscope *20*
1.5.4 Autofluorescence Imaging of Human Stem Cells *21*
1.5.5 Multiphoton Imaging during Differentiation *21*
1.5.6 Nanoprocessing *25*
1.6 Discussion and Conclusion *28*
References *31*

2 *In Vivo* Nanosurgery *35*
Leonardo Sacconi and Francesco S. Pavone
2.1 Introduction *35*
2.2 Physical Mechanisms *36*
2.3 Experimental Setup *37*
2.4 Subcellular Nanosurgery *38*
2.5 *In Vivo* Nanosurgery *41*

Laser Imaging and Manipulation in Cell Biology. Edited by Francesco S. Pavone

ISBN: 978-3-527-40929-7

2.6 Conclusions 46
References 47

Part Two Light–Molecule Interaction Mechanisms 49

3 Interaction of Pulsed Light with Molecules: Photochemical and Photophysical Effects 51
Gereon Hüttmann
3.1 Introduction 51
3.2 Basic Photophysics 52
3.2.1 Electronic States of Molecules and the Jablonski Diagram 53
3.2.2 Changes between States 54
3.3 Bleaching and Excited State Absorption 57
3.4 Multiphoton Absorption and Ionization 60
3.5 Relevance for Biomedical Applications 61
3.5.1 Effectiveness of Pulsed Lasers for Photodynamic Therapy 61
3.5.2 Reduction of Photobleaching in Laser Scanning Microscopy 63
3.5.3 Super-Resolution by Optical Depletion of the Fluorescent State 65
3.6 Conclusions 67
References 68

4 Chromophore-Assisted Light Inactivation: A Twenty-Year Retrospective 71
Daniel G. Jay
4.1 Historical Perspective 71
4.2 Family of CALI-Based Technologies 72
4.3 Spatial Restriction of Damage 73
4.4 Mechanism of CALI 74
4.5 Micro-CALI 75
4.6 Intracellular Targets of CALI 75
4.7 CALI *In Vivo* 76
4.8 High-Throughput Approaches 77
4.9 Future of CALI 77
References 78

5 Photoswitches 83
Andrew A. Beharry and G. Andrew Woolley
5.1 Introduction 83
5.2 Synthetic Photoswitches 84
5.3 Natural Photoswitches 89
References 93

6 Optical Stimulation of Neurons 99
S.M. Rajguru, A.I. Matic, and C.-P. Richter
6.1 Introduction 99

6.2 Neural Stimulation with Optical Radiation *100*
6.2.1 General Considerations *100*
6.2.2 Effect of Optical Stimulation on Excitability *101*
6.2.3 Optical Stimulation via Photochemical Mechanism *101*
6.2.3.1 Activation via Exogenously Added Chromophore *102*
6.2.3.2 Activation of an Endogenous Chromophore *102*
6.3 Direct Optical Stimulation of Neural Tissue *103*
6.3.1 Pulsed Infrared Lasers for Direct Stimulation *104*
6.3.1.1 Stimulation of Peripheral Nerves *104*
6.3.1.2 Stimulation of Cranial Nerves *105*
6.3.1.3 Advantages of Optical Stimulation *106*
6.3.2 Challenges for Optical Stimulation *106*
6.3.2.1 Mechanism of Stimulation with Optical Radiation *106*
6.3.2.2 Safety of Optical Stimulation *108*
References *108*

Part Three Tissue Optical Imaging *113*

7 Light–Tissue Interaction at Optical Clearing *115*
Elina A. Genina, Alexey N. Bashkatov, Kirill V. Larin, and Valery V. Tuchin
7.1 Introduction *115*
7.2 Light–Tissue Interaction *115*
7.3 Tissue Clearing *120*
7.3.1 Compression and Stretching *122*
7.3.2 Dehydration and Coagulation *122*
7.3.3 Optical Immersion *124*
7.4 Enhancers of Diffusion *130*
7.4.1 Diffusion through Membranes *130*
7.4.2 Chemical Agents *131*
7.4.3 Physical Methods *132*
7.5 Diffusion Coefficient Estimation *133*
7.5.1 Spectroscopic Methods *135*
7.5.2 Optical Coherence Tomography *138*
7.6 Applications of Tissue Optical Clearing to Different Diagnostic and Therapeutic Techniques *144*
7.6.1 Glucose Sensing *145*
7.6.1.1 NIR Technique *145*
7.6.1.2 OCT Technique *147*
7.6.1.3 Photoacoustic Technique *147*
7.6.1.4 Raman Spectroscopy *148*
7.6.2 Tissue Imaging *149*
7.6.2.1 Confocal Microscopy *149*
7.6.2.2 Nonlinear Microscopy *149*
7.6.2.3 Multiphoton Microscopy *151*

7.6.2.4 Polarized Microscopy *152*
7.6.2.5 Optical Projection Tomography *153*
7.6.3 Therapeutic Applications *153*
7.7 Conclusion *155*
References *156*

Part Four Laser Tissue Operation *165*

8 Photodynamic Therapy – the Quest for Improved Dosimetry in the Management of Solid Tumors *167*
Ann Johansson and Stefan Andersson-Engels
8.1 Introduction *167*
8.2 Photodynamic Reactions *168*
8.2.1 Direct PDT Effects *170*
8.2.2 Vascular PDT Effects *170*
8.2.3 Immunological Effects *170*
8.2.4 Manipulating the PDT Effect *171*
8.3 Photosensitizers *173*
8.3.1 Photophysical Properties *175*
8.3.2 Pharmacokinetics and Tumor Selectivity *176*
8.4 PDT Dosimetry Models *177*
8.4.1 Explicit Dosimetry *179*
8.4.2 Implicit Dosimetry *181*
8.4.3 Direct Dosimetry *182*
8.4.4 Biological Response *184*
8.4.5 Summary of PDT Dose Models *184*
8.5 Clinical Implementation *185*
8.6 Where is PDT Heading? *188*
8.6.1 Novel Applications *189*
8.6.2 Novel Light Delivery Modes *190*
8.6.3 Novel Photosensitizer Development *190*
8.6.4 Novel Implementation of Dosimetry and Dosimetric Measurements *192*
References *193*

9 Laser Welding of Biological Tissue: Mechanisms, Applications and Perspectives *203*
Paolo Matteini, Francesca Rossi, Fulvio Ratto, and Roberto Pini
9.1 Introduction *203*
9.2 Mechanism of Thermal Laser Welding *206*
9.2.1 Composition of the Extracellular Matrix *206*
9.2.2 Thermal Modifications of Connective Tissues and Mechanism of Welding *207*
9.2.2.1 Hard Laser Welding *210*
9.2.2.2 Moderate Laser Welding *210*

9.2.2.3 Soft Laser Welding *210*
9.3 Temperature Control in Laser Welding Procedures *211*
9.3.1 Control Systems of Temperature Dynamics *211*
9.4 Surgical Applications of Thermal Laser Welding *214*
9.4.1 Laser Welding in Ophthalmology *215*
9.4.1.1 Clinical Applications in the Transplant of the Cornea *215*
9.4.1.2 Preclinical Applications in the Closure of the Lens Capsule *218*
9.4.2 Laser Welding in Vascular Surgery *219*
9.5 Future Perspectives *223*
References *226*

Conclusions *233*
Francesco S. Pavone
References *242*

Index *243*

List of Contributors

Stefan Andersson-Engels
Lund University
Department of Physics
PO Box 118
223 62 Lund
Sweden

Alexey N. Bashkatov
Saratov State University
Research-Educational Institute
of Optics and Biophotonics
410012 Saratov
Russia

Andrew A. Beharry
University of Toronto
Department of Chemistry
80 St. George St.
Toronto, ON M5S 3H6
Canada

Elina A. Genina
Saratov State University
Research-Educational Institute of Optics
and Biophotonics
410012 Saratov
Russia

Gereon Hüttmann
University of Lübeck
Institute of Biomedical Optics
Peter-Monnik-Weg 4
23562 Lübeck
Germany

Daniel G. Jay
Tufts University School of Medicine
Department of Physiology
Boston, MA
USA

Ann Johansson
Munich University Clinic
LIFE Center
Marchioninistr. 23
81377 Munich
Germany

Karsten König
Saarland University
Faculty of Mechatronics and Physics
D-66123 Saarbrücken
Germany

and

JenLab GmbH
D-07745 Jena
Germany

Laser Imaging and Manipulation in Cell Biology. Edited by Francesco S. Pavone

ISBN: 978-3-527-40929-7

Kirill V. Larin
Saratov State University
Research-Educational Institute of Optics and Biophotonics
410012 Saratov
Russia

and

University of Houston
Department of Biomedical Engineering
Houston, TX
USA

A.I. Matic
Northwestern University
Feinberg School of Medicine
Department of Otolaryngology
303 East Chicago Avenue
Chicago, IL 60611-3008
USA

Paolo Matteini
Consiglio Nazionale delle Ricerche
"Nello Carrara" Institute of Applied Physics
Florence
Italy

Francesco S. Pavone
University of Florence
LENS, European Laboratory for Non-Linear Spectroscopy
Via Nello Carrara 1
I-50019 Sesto Fiorentino, Florence
Italy

Roberto Pini
Consiglio Nazionale delle Ricerche
"Nello Carrara" Institute of Applied Physics
Florence
Italy

S.M. Rajguru
Northwestern University
Feinberg School of Medicine
Department of Otolaryngology
303 East Chicago Avenue
Chicago, IL 60611-3008
USA

Fulvio Ratto
Consiglio Nazionale delle Ricerche
"Nello Carrara" Institute of Applied Physics
Florence
Italy

C.-P. Richter
Northwestern University
Feinberg School of Medicine
Department of Otolaryngology
303 East Chicago Avenue
Chicago, IL 60611-3008
USA

Francesca Rossi
Consiglio Nazionale delle Ricerche
"Nello Carrara" Institute of Applied Physics
Florence
Italy

Leonardo Sacconi
University of Florence
LENS, European Laboratory for Non-Linear Spectroscopy
Via Nello Carrara 1
I-50019 Sesto Fiorentino, Florence
Italy

Valery V. Tuchin
Saratov State University
Research-Educational Institute of Optics and Biophotonics
410012 Saratov
Russia

Russian Academy of Sciences
Institute of Precise Mechanics and Control
410028 Saratov
Russia

Aisada Uchugonova
Saarland University
Faculty of Mechatronics and Physics
D-66123 Saarbrücken
Germany

G. Andrew Woolley
University of Toronto
Department of Chemistry
80 St. George St.
Toronto, ON M5S 3H6
Canada

Introduction

Francesco S. Pavone

Since the development of nonlinear laser imaging tools, such as the two-photon technique [1] for example, many technological advancements have been made in the field of microscopy and, more generally, imaging. It took more than 60 years to move from the discovery of the two-photon interaction [2] to its exploitation in microscopy. Since the 1990s, an exponential growth of publications in the field of microscopy (Figure 1) has led to the introduction of the two-photon technique in the laboratories of many researchers worldwide.

Since the first interaction schemes, where all photons were accumulated and collected on the detector after the laser irradiation (integration mode), other kinds of investigation modes have been developed, based, for example, on the lifetime response of the fluorescent molecule (fluorescent lifetime microscopy), on the spectral behavior of fluorescence emission (multispectral two-photon emission), or on the ability of the illuminated molecule to double the frequency of the coherent excitation due to its nonlinear susceptibility (second- and third-harmonic generation microscopy).

Further developments in microscopy have led to other nonlinear interaction schemes such as coherent anti-Stoke Raman spectroscopy (CARS) [3] (Figure 2) and resonant Raman scattering [4].

The nonlinear characteristic of the interaction of pulsed light with a molecule has also led to applications that are useful in increasing the resolution below the diffraction limited barrier [5].

All these imaging tools, together with well-developed photon based technology, such as confocal microscopy, have enlarged the field of applications in biological imaging of molecules, cells, and tissues.

Consequently, the new frontier of cell biology imaging has moved from a fixed cell to a living cell with the advent of the laser and more sensitive wide-field fluorescent microscopes. The advent of confocal microscope has improved the axial resolution, while the application of multiphoton processes has finally permitted the study of cell biology in tissues and, consequently, in living organisms, as well as allowing optical manipulation [6].

Laser Imaging and Manipulation in Cell Biology. Edited by Francesco S. Pavone

ISBN: 978-3-527-40929-7

文档篇幅过长，请跳转百度云盘下载：
链接：https://pan.baidu.com/s/1P8HJOQ_eVI28hmStwxMWFg
提取码：hf75