

Contents

<i>List of Contributors</i>	page x
<i>Foreword by Georg Nagel</i>	xxi
<i>Preface</i>	xxv
I Optogenetics in Model Organisms	1
1 Introduction to Optogenetics: From Neuronal Function to Mapping and Disease Biology Krishnarao Appasani and Raghu K. Appasani	3
2 Uncovering Key Neurons for Manipulation in Mammals Boris V. Zemelman	18
3 From Connectome to Function: Using Optogenetics to Shed Light on the <i>Caenorhabditis elegans</i> Nervous System Koutarou D. Kimura and Karl Emanuel Busch	37
4 From Synapse to Behavior: Optogenetic Tools for the Investigation of the <i>Caenorhabditis elegans</i> Nervous System Jatin Nagpal	55
5 Using Optogenetics <i>In Vivo</i> to Stimulate Regeneration in <i>Xenopus laevis</i> Dany S. Adams, Ai-Sun Tseng, and Michael Levin	66
II Opsin Biology, Tools, and Technology Platform	77
6 Sodium and Engineered Potassium Light-Driven Pumps Vitaly Shevchenko, Ivan Gushchin, Vitaly Polovinkin, Kirill Kovalev, Taras Balandin, Valentin Borshchevskiy, and Valentin Gordeliy	79
7 Methods for Simultaneous Electrophysiology and Optogenetics <i>In Vivo</i> Yonatan Katz and Ilan Lampl	93
8 Application of an Optogenetic Technique to a Study of Activity-dependent Axon Growth in the Developing Cortex Olga Malyshevskaya and Nobuhiko Yamamoto	109

9	Development of an Optogenetic Tool to Regulate Protein Stability <i>In Vivo</i>	
	Christian Renicke and Christof Taxis	118
10	Photoactivatable Nucleotide Cyclases for Synthetic Photobiology Applications	
	Marc Folcher	132
11	Bioluminescence Activation of Light-sensing Molecules	
	Ute Hochgeschwender	151
III Optogenetics in Neurobiology, Brain Circuits, and Plasticity		167
12	Optogenetics for Neurological Disorders: What Is the Path to the Clinic?	
	William F. Kaemmerer	169
13	Optogenetic Control of Astroglia	
	Anja G. Teschemacher and Sergey Kasparov	181
14	Optogenetics for Neurohormones and Neuropeptides: Focus on Oxytocin	
	Yan Tang, Jérôme Wahis, Meggane Melchior, Valery Grinevich, and Alexandre Charlet	196
15	Optogenetic Approaches to Investigating Brain Circuits	
	Alexander M. Herman, Jay M. Patel, and Benjamin R. Arenkiel	206
16	Optogenetic Mapping of Neuronal Connections and their Plasticity	
	Michael M. Kohl and Dennis Kätzel	224
IV Optogenetics in Learning, Neuropsychiatric Diseases, and Behavior		239
17	Optogenetics to Study Reward Learning and Addiction	
	Andrea L. Gutman and Ryan T. LaLumiere	241
18	Optogenetics and the Dissection of Neural Circuits Underlying Depression and Substance-use Disorders	
	Barbara Juarez, Allyson K. Friedman, and Ming-Hu Han	257
19	Optogenetics Research in Behavioral Neuroscience: Insights into the Brain Basis of Reward Learning and Goal-directed Behavior	
	Adam C. G. Crego, Stephen E. Chang, William N. Butler, and Kyle S. Smith	276
20	Toward an Optogenetic Therapy for Epilepsy	
	Jan Tønnesen, Marco Ledri, and Merab Kokaia	292
21	Using Optogenetics and Stem Cell-derived Neural Engraftment Techniques to Restore Lost Motor Function	
	J. Barney Bryson and Linda Greensmith	308
V Optogenetics in Vision Restoration and Memory		325
22	Optogenetics in Treating Retinal Disease	
	Dasha Nelidova and Federico Esposti	327
23	Optogenetics for Vision Recovery: From Traditional to Designer Optogenetic Tools	
	Sonja Kleinlogel	337

24	A Promise of Vision Restoration Grégory Gauvain, Antoine Chaffiol, Jens Duebel, and Serge A. Picaud	356
25	Holographic Optical Neural Interfacing with Retinal Neurons Adi Schejter Bar-Noam, Inna Gefen, and Shy Shoham	371
26	Strategies for Restoring Vision by Transducing a Channelrhodopsin Gene into Retinal Ganglion Cells Hiroschi Tomita and Eriko Sugano	382
27	Optogenetic Dissection of a Top-down Prefrontal to Hippocampus Memory Circuit Priyamvada Rajasethupathy	393
VI	Optogenetics in Sleep, Prosthetics, and Epigenetics of Neurodegenerative Diseases	405
28	Optogenetic Dissection of Sleep-Wake Control: Evidence for a Thalamic Control of Sleep Architecture Charles-Francois Vincent Latchoumane and Hee-Sup Shin	407
29	Optogenetics and Auditory Implants Jenny X. Chen, Elliott Kozin, M. Christian Brown, and Daniel J. Lee	421
30	Optogenetic Stimulation for Cochlear Prosthetics Victor H. Hernandez Gonzalez and Tobias Moser	442
31	The Role of Amino Acids in Neurodegenerative and Addictive Diseases Joan Fallon	453
32	Optogenetics in Deep Brain Stimulation: Ethical Considerations Sabine Müller and Henrik Walter	463
	Index	470

The color plates are to be found between pages 324 and 325