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## Preface

During the past decade, specific light-sensitive modules have paved the way for the development of “Optogenetics,” a technology using light switches for precise and spatial control of signaling pathways in individual cells and even in complex biological systems. Although the idea behind controlling cellular, physiological, and behavioral processes using external light was an old scientific desire, crucial factor for rapid development of optogenetics was the discovery of a handful of algal sensory photoreceptors, i.e., light-gated ion channels (channel-rhodopsins), which can be easily used to control neural spiking with light. Concurrently, other light-sensitive modules were engineered to generate new photoswitches to control protein activity, protein localization, and gene expression. Fast progress in genome and transcriptome sequencing towards identification of new photoswitchable proteins as well as engineering of new variants with modified absorption and activity properties enriched the optogenetic toolkit and allowed fine-tuned regulation of multiple signaling pathways. In the light of current advances and growing diversity, future application of optogenetic tools for modulation of distinct cellular signaling pathways, even in complex biological systems, without need for chemical additives, seems to be more favorable in comparison to chemical systems.

In this book leading experts on optogenetics, synthetic biology, and neurobiology provide their state-of-the-art protocols and take a close look at current research and its promising applications. This volume provides a collection of the most recently developed technical protocols on optogenetic applications in neuroscience, brain mapping, treatment of neurological disorders, and restoration of visual function. Moreover, several introductory and discussion chapters give a deep, wide overview about sources and diversity of optogenetic tools, design strategies, and potential application in other fields like plant research. I assembled the volume to stimulate an interdisciplinary view of optogenetic applications and its great potential to develop as a fantastic molecular tool for basic research as well as biomedical and biotechnological applications.

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