

---

# Contents

|                                                                                                                                                                                           |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <i>Preface</i> . . . . .                                                                                                                                                                  | <i>v</i>  |
| <i>Contributors</i> . . . . .                                                                                                                                                             | <i>ix</i> |
| PART I GENERAL STRATEGIES AND CONSIDERATIONS                                                                                                                                              |           |
| 1 Synthetic Protein Switches: Theoretical and Experimental Considerations . . . .<br><i>Viktor Stein</i>                                                                                  | 3         |
| 2 Construction of Allosteric Protein Switches by Alternate Frame Folding<br>and Intermolecular Fragment Exchange . . . . .                                                                | 27        |
| <i>Jeung-Hoi Ha and Stewart N. Loh</i>                                                                                                                                                    |           |
| 3 Construction of Protein Switches by Domain Insertion<br>and Directed Evolution . . . . .                                                                                                | 43        |
| <i>Lucas F. Ribeiro, Tiana D. Warren, and Marc Ostermeier</i>                                                                                                                             |           |
| PART II PEPTIDE SWITCHES                                                                                                                                                                  |           |
| 4 Catalytic Amyloid Fibrils That Bind Copper to Activate Oxygen . . . . .                                                                                                                 | 59        |
| <i>Alex Sternisha and Olga Makhlynets</i>                                                                                                                                                 |           |
| PART III FLUORESCENT AND BIOLUMINESCENT SENSORS                                                                                                                                           |           |
| 5 Ancestral Protein Reconstruction and Circular Permutation<br>for Improving the Stability and Dynamic Range of FRET Sensors . . . . .                                                    | 71        |
| <i>Ben E. Clifton, Jason H. Whitfield, Inmaculada Sanchez-Romero,<br/>Michel K. Herde, Christian Henneberger, Harald Janovjak,<br/>and Colin J. Jackson</i>                               |           |
| 6 Method for Developing Optical Sensors Using a Synthetic Dye-Fluorescent<br>Protein FRET Pair and Computational Modeling and Assessment . . . . .                                        | 89        |
| <i>Joshua A. Mitchell, William H. Zhang, Michel K. Herde,<br/>Christian Henneberger, Harald Janovjak, Megan L. O'Mara,<br/>and Colin J. Jackson</i>                                       |           |
| 7 Rational Design and Applications of Semisynthetic Modular<br>Biosensors: SNIFITs and LUCIDs . . . . .                                                                                   | 101       |
| <i>Helen Farrants, Julien Hiblot, Rudolf Griss, and Kai Johnsson</i>                                                                                                                      |           |
| 8 Ultrasensitive Firefly Luminescent Intermediate-Based Protein-Protein<br>Interaction Assay (FlimPIA) Based on the Functional Complementation<br>of Mutant Firefly Luciferases . . . . . | 119       |
| <i>Yuki Ohmuro-Matsuyama and Hiroshi Ueda</i>                                                                                                                                             |           |
| 9 Quantitative and Dynamic Imaging of ATM Kinase Activity . . . . .                                                                                                                       | 131       |
| <i>Shyam Nyati, Grant Young, Brian Dale Ross, and Alnawaz Rehemtulla</i>                                                                                                                  |           |

PART IV  $\beta$ -LACTAMASE SENSORS

- 10 Creation of Antigen-Dependent  $\beta$ -Lactamase Fusion Protein Tethered  
by Circularly Permuted Antibody Variable Domains . . . . . 149  
*Hiroto Iwai, Miki Kojima-Misaizu, Jinhua Dong, and Hiroshi Ueda*
- 11 Protein and Protease Sensing by Allosteric Derepression . . . . . 167  
*Hui Chin Goh, Farid J. Ghadessy, and Saurabh Nirantar*
- 12 DNA-Specific Biosensors Based on Intramolecular  $\beta$ -Lactamase-Inhibitor  
Complex Formation . . . . . 179  
*Wouter Engelen and Maarten Merks*

## PART V PROTEOLYTIC SENSORS

- 13 Engineering and Characterizing Synthetic Protease Sensors and Switches . . . . 197  
*Viktor Stein and Kirill Alexandrov*
- 14 Characterizing Dynamic Protein-Protein Interactions Using the Genetically  
Encoded Split Biosensor Assay Technique Split TEV . . . . . 219  
*Jan P. Wintgens, Moritz J. Rossner, and Michael C. Wehr*

## PART VI OPTOGENETIC SWITCHES

- 15 Development of a Synthetic Switch to Control Protein Stability  
in Eukaryotic Cells with Light. . . . . 241  
*Christof Taxis*
- 16 Light-Regulated Protein Kinases Based on the CRY2-CIB1 System. . . . . 257  
*Wignand W.D. Mühlhäuser, Maximilian Hörner, Wilfried Weber,  
and Gerald Radziwill*
- 17 Yeast-Based Screening System for the Selection of Functional  
Light-Driven K<sup>+</sup> Channels. . . . . 271  
*Cristian Cosentino, Laura Alberio, Gerhard Thiel, and Anna Moroni*
- 18 Primer-Aided Truncation for the Creation of Hybrid Proteins . . . . . 287  
*Robert Stabel, Birthe Stüven, Robert Ohlendorf, and Andreas Möglich*

## PART VII CELLULAR SIGNALING SWITCHES

- 19 Engineering Small Molecule Responsive Split Protein Kinases . . . . . 307  
*Javier Castillo-Montoya and Indraneel Ghosh*
- 20 Directed Evolution Methods to Rewire Signaling Networks . . . . . 321  
*Raphaël B. Di Roberto, Benjamin M. Scott, and Sergio G. Peisajovich*

- Index* . . . . . 339

Synthetic Protein Switches

Methods and Protocols

Stein, V. (Ed.)

2017, XI, 341 p. 59 illus., 31 illus. in color., Hardcover

ISBN: 978-1-4939-6938-8

A product of Humana Press