

LABEL-FREE BIOSENSORS

Label-free biosensors use biological or chemical receptors to detect analytes (molecules) in a sample. They give detailed information on the binding selectivity, affinity, and, in many cases, the stoichiometry, kinetics, and thermodynamics of an interaction. Although they can be powerful tools in the hands of a skilled user, there is often a lack of knowledge regarding the best way to utilize label-free assays to screen for biologically active molecules and to accurately and precisely characterize molecular recognition events.

This book reviews both established and newer label-free techniques. It is intended to give both the expert user and the general reader insight into the field from expert opinion leaders and practitioners of these techniques. Chapters also contain worked examples that are written to guide the reader through the basics of experimental design, setup, assay development, and data analysis.

Matthew A. Cooper is Founder and Managing Director of Cambridge Medical Innovations and Distinguished Australia Fellow at the University of Queensland. Dr. Cooper has consulted widely for biosensor, biotechnology, and pharmaceutical companies in the United Kingdom, Europe, and the United States. He is a review panel member for Biotechnology and Biological Sciences Research Council, Engineering and Physical Sciences Research Council, National Institutes of Health, National Institute of Allergy and Infectious Diseases, and Science Foundation Ireland and a Fellow of the Royal Society of Medicine.

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Frontmatter
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Label-Free Biosensors

TECHNIQUES AND APPLICATIONS

Edited by

Matthew A. Cooper

The University of Queensland



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Contributors

J. Michael Brandts

Vice President
MicroCal
Northampton, MA

Richard K. Brown, PhD

President and CEO
MicroCal
Northampton, MA

Matthew A. Cooper, PhD

Managing Director
Cambridge Medical Innovations
Cambridge, UK

Distinguished Australia Fellow
Institute for Molecular
Bioscience
University of Queensland
St. Lucia, Australia

Brian T. Cunningham

Associate Professor
University of Illinois
Department of Electrical and
Computer Engineering
Urbana, IL

Jack Fang, PhD

Strategic Analysis Manager
Corning® Epic® System
Corning, Inc.
Corning, NY

Ye Fang, PhD

Research Manager
Cellular Biophysics
Corning, Inc.
Corning, NY

Anthony G. Frutos, PhD

BioAssay Development Manager
Science & Technology
Corning, Inc.
Corning, NY

Michael Hallstrom

Assistant Product Line Manager
Corning® Epic® System
Corning, Inc.
Corning, NY

Walter Huber, PhD

Pharmaceutical Research Discovery
Technology
F. Hoffmann-La Roche
Basel, Switzerland

Robert Karlsson

Research and Development Director,
System and Applications
Department
GE Healthcare
Uppsala, Sweden

Francis Markey

GE Healthcare
Uppsala, Sweden

Contributors**Ryan P. McGuinness**

Senior Scientist
Drug Discovery
MDS Analytical Technologies
Sunnyvale, CA

David G. Myszka, PhD

Director
Center for Biomolecular Interaction
Analysis
School of Medicine
University of Utah
Salt Lake City, UT

Ronan O'Brien, PhD

Head of Applications Research
MicroCal
Northampton, MA

William B. Peters, PhD

Applications Scientist and Head of
Training
MicroCal
Northampton, MA

Rebecca L. Rich, PhD

Senior Research Scientist
Center for Biomolecular Interaction
Analysis
School of Medicine
University of Utah
Salt Lake City, UT

Elizabeth Tran, PhD

Senior Research Scientist
Science & Technology
Corning, Inc.
Corning, NY

Edward Verdonk, PhD

Senior Scientist
Drug Discovery
MDS Analytical Technologies
Sunnyvale, CA

Xinying Xie

Field Application Scientist
Corning® Epic® System
Corning, Inc.
Houston, TX

Preface

Over the past two decades the benefits of biosensor analysis have begun to be recognized in many areas of analytical science, research, and development, with analytical systems now used routinely as mainstream research tools in many laboratories in many fields. Simplistically, biosensors can be defined as devices that use biological or chemical receptors to detect analytes (molecules) in a sample. They give detailed information on the binding affinity and in many cases also the binding stoichiometry, thermodynamics, and kinetics of an interaction. Label-free biosensors, by definition, do not require the use of reporter elements (fluorescent, luminescent, radiometric, or colorimetric) to facilitate measurements. Instead, a receptor molecule is normally connected in some way to a transducer that produces an electrical signal in real time. Other techniques such as isothermal titration calorimetry (ITC), nuclear magnetic resonance (NMR), and mass spectrometry require neither reporter labels nor surface-bound receptors. In all cases detailed information on an interaction can be obtained during analysis while minimizing sample processing requirements. Unlike label- and reporter-based technologies that simply confirm the presence or absence of a detector molecule, label-free techniques can provide direct information on analyte binding to target molecules typically in the form of mass addition or depletion from the surface of a sensor substrate or via changes in a physical bulk property (such as the heat capacity) of a sample. Until recently, label-free technologies have failed to gain widespread acceptance due to technical constraints, low throughput, high user expertise requirements, and cost. Whereas they have proved to be powerful tools in the hands of a skilled user, they have not always been readily adapted to everyday lab use in which simple-to-understand results are a prerequisite. Despite this limitation, the potential today for label-free approaches to complement or even displace other detection technologies has never been higher.

This book covers established label-free technologies and emerging developments in label-free detection systems, their underlying technology principles, and end-user case studies that reveal the power and limitations of such biosensors. The chapters are intended to give both the expert user and the general reader interested in the technologies and applications behind label-free biosensors an insight into the field from expert opinion leaders and practitioners. As such, most chapters contain one or more worked examples that guide the reader through

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the basics of experimental design, setup, assay development, and data analysis. The book is heavily weighted toward applications using optical biosensors and surface plasmon resonance (SPR) instrumentation. This is primarily because of the overwhelming bias in the installed base of optical biosensors due to their early commercialization and uptake. Other label-free technologies conspicuous by their absence from this volume include analytical ultracentrifugation, nuclear magnetic resonance spectroscopy, and mass spectroscopy. These will be covered as part of a new cluster of titles on bioanalytical techniques and applications.

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