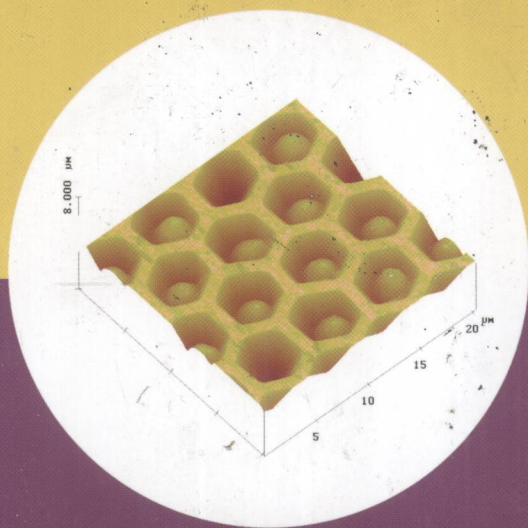


# OPTICAL BIOSENSORS

TODAY AND TOMORROW



Frances S. Ligler and Chris Rowe Taitt

Second Edition

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# OPTICAL BIOSENSORS: TODAY AND TOMORROW

Edited by

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**OPTICAL BIOSENSORS:  
TODAY AND TOMORROW**

### ***Dedication***

*The authors thank Kristyn Thiel for her capable assistance in the compilation of these chapters. We acknowledge financial support from NRL Work Unit 62-6006. We dedicate this book to our husbands, George and John, whose support gave us the courage to even contemplate undertaking a second edition of this book.*

# Preface

When we prepared the first edition of *Optical Biosensors*, titled *Optical Biosensors: Present and Future*, the field of optical biosensors was rapidly evolving on the coattails of advances in optical telecommunications. Since that time, there has been an explosion of new and exciting science and engineering that has direct bearing on the ability of optical biosensors to have increased and widespread application. For instance, advances in the “nano” realm – nanoelectronics, nanomaterials, nanofluidics – have paved the way for development and integration of new methods and materials for signal generation and transduction, as well as for miniaturization and automation of existing systems. The inherently cross-disciplinary nature of biosensing creates fertile ground for new perspectives for addressing critical challenges. In our experience, the best team for creating biosensors includes experts not only in biochemistry, chemistry, and optical physics, but also mechanical, chemical, electrical and bio-engineering. For this reason, *Optical Biosensors: Today and Tomorrow* includes a number of chapters describing future relevant technologies, in addition to chapters describing state-of-the-art optical biosensor systems.

This book is divided into two parts. “Optical Biosensors: Today” includes comprehensive discussions of technologies that have proven utility and, in many cases, are commercially available now. Seven of these chapters have been updated from the previous edition of *Optical Biosensors*, with descriptions of highly noteworthy developments over the last 6 years in the areas of biosensors based on fiber optics and planar waveguides, flow immunosensors, electrochemiluminescence, and surface plasmon resonance. Due to the increasing popularity of surface-enhanced Raman sensors, a chapter on this technology has been added. “Optical Biosensors: Tomorrow” consists of discussions of science and technologies that the editors consider exciting in terms of their potential

to revolutionize future biosensor systems. Chapters with new material on aptamers, molecularly imprinted polymers, intracellular sensing, and microfluidics are again featured, and new chapters on cavity ring down spectroscopy, optical cantilevers, microarrays, single-domain antibodies, and nanoparticles have been added.

Contributors were tasked with describing the underlying principles behind each technology, detailing the demonstrated and potential applications, and providing a (hopefully!) objective view of the advantages and disadvantages of the technology. We also asked them to provide a short history of their system or science, not only to provide a context for the current state of the art, but also to recognize the pioneering work on which the present and the future of optical biosensing is based. Finally, the authors gaze into their crystal balls to envision the place of their technology in the world of tomorrow. These last observations are meant to be both candid and thought-provoking.

The successful marriage of biomolecules, cells, and tissues with optoelectronic detection platforms, not to mention the transformation of such tools into user-friendly systems, requires broad understanding of the possible scientific and technical options. This task becomes less daunting with the ability to reference factual summaries and informed opinions provided by the leaders in the field. We therefore thank our contributing authors for the exposition of their insights into this rapidly expanding field. We are also very grateful to both the pioneering spirits who have historically led the field and the hardy souls who continue to make breakthroughs in biological sensing. We thank them all for their hard work, willingness to share their ideas and perspicacity, and their devotion to a field whose challenges continue to change and inspire.

And finally, thank you for opening this book. It is for you, the curious reader, that *Optical Biosensors: Today and Tomorrow* has been created.

Fran and Chris

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