Preface

The discipline of biophotonics or biomedical optics has undergone a fascinating journey in the past several decades and it is still growing rapidly. As the name *biophotonics* implies, the application of this field to biological disciplines is based on the wide range of photonics technologies, which involve the generation, detection, and control of photons for enabling functions such as transferring or processing information, analyzing material characteristics, sensing or measuring changes in physical parameters, and modifying material characteristics. Basically biophotonics deals with the interaction between light and biological material. The resulting interactions can be used in almost all biomedical areas for basic life science research and for biomedical diagnosis, therapy, monitoring, imaging, and surgery.

Owing to the importance of biophotonics to all aspects of human health, it is essential that a wide range of biomedical researchers, healthcare professionals, clinical technicians, and biomedical engineers have a good understanding of biophotonics and its applications. To address the attainment and implementation of these skills, this book provides the basic material for a one-semester entry-level course in the fundamentals and applications of biophotonics technology for senior or postgraduate students. It also will serve well as a working reference or as a short-course textbook for biomedical researchers, practicing physicians, healthcare professionals, clinical technicians, and biomedical engineers and technicians dealing with the design, development, and application of photonics components and instrumentation to biophotonics issues.

In Chap. 1–5 the sequence of topics takes the reader systematically from the underlying principles of light and biology, through the fundamentals of optical fiber light guiding, and then through optical sources and photodetection methods. Next, the topics in Chap. 6–10 address the concepts of light–tissue interactions, various optical probes and photonics sensing techniques, the principles of microscopy and spectroscopy, and biophotonics imaging modalities. The final chapter discusses advanced techniques and developments such as optical trapping, miniaturized instruments, single nanoparticles detection, and optogenetics procedures. By mastering these fundamental topics the reader will be prepared not only to contribute to

current biomedical photonics disciplines, but also to understand quickly any further technology developments for future enhanced biophotonics developments.

The background required to study the book is that of typical senior-level science and engineering students. This background includes introductory biology and chemistry, calculus, and basic concepts of electromagnetism and optics as presented in a freshman physics course. To assist readers in learning the material and applying it to practical situations, 104 worked examples are given throughout the text. A collection of 129 homework problems is included to test the readers' comprehension of the material covered, and to extend and elucidate the text.

The articles and books cited as references in the text were selected from among numerous texts and thousands of papers in the literature relating to the material covered in each chapter. Because biophotonics brings together research, development, and application efforts from many different scientific, medical, and engineering disciplines, these references are a small sample of the major contributions to biophotonics. A number of these references are review papers and provide a starting point for delving deeper into any given topic.

Newton, USA Gerd Keiser

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Keiser, G.
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