Preface

Photonics has been employed as a powerful tool in biological and chemical detection for many years. Compared to other sensing technologies, the sensing transduction signal from photonic sensors can be generated from optical parameters in both the spectral and time domains, including refractive index, optical absorption, fluorescence, polarization, lifetime, and even nonlinear optical processes such as lasing, Raman scattering, and multiphoton absorption and emission. These different types of signals are complementary to each other and provide vast amount of information regarding the presence and interaction of bio/chemical molecules.

In recent years, rapid advancements in photonic technologies have significantly enhanced the photonic bio/chemical sensor performance, especially in the areas of (1) interaction between the light and analyte, (2) device miniaturization and multiplexing, and (3) fluidic design and integration. This has led to drastic improvements in sensor sensitivity, enhanced detection limit, advanced fluidic handling capability, lower sample consumption, faster detection time, and lower overall detection cost per measurement.

This book consists of 19 chapters written by the worldwide experts in photonic sensors. It is intended to capture most of the important up-to-date fascinating research and applications of novel photonic structures in bio/chemical sensing. The subjects extend from optical ring resonators, distributed feedback resonators, Fabry-Pérot interferometers, Mach-Zehnder interferometers, Young interferometers, and spinning-disc interferometers to fiber gratings, photonic crystals, micro/nanofibers, photonic wires, antiresonant reflecting optical waveguides (ARROWs), slot waveguides, metal-clad waveguides, reverse symmetry waveguides, and folded waveguides.

The topics in this book are arranged into three sections dealing with (1) photonic chemical vapor sensing, (2) photonic biological sensing, and (3) integration of the photonic sensors with microfluidics. However, it should be emphasized that a number of photonic sensors presented in this book combine or integrate multiple photonic structures to achieve enhanced performance. Additionally, many sensors in this book are capable of performing both biological sensing and liquid/vapor

chemical sensing. The above categorization is done simply out of consideration for balancing the book's content and giving readers some general thematic guidance.

While this book surveys a diversified range of photonic sensor structures, it is certainly impossible in one book volume to provide full coverage of all such structures known to science. Thus plasmonic photonic structures, photonic crystal fibers, and nanoparticles will be covered by other upcoming books in this Springer Series "Integrated Analytical Systems."

This book will be of interest to researchers from multiple disciplines that include physicists, chemists, engineers, nanotechnologists, and biologists, who work in the area of bio/chemical detection and analysis in university laboratories, the biotechnology industry, the healthcare industry, homeland security and defense, pharmaceuticals, the food industry, and environment protection. The book will also serve as an excellent resource for graduate students wanting an introduction to the exciting and fast-pacing research frontiers in photonic bio/chemical sensors.

I would like to thank all of the contributors for writing truly informative and stimulating chapters. I am also indebted to Dr. Radislav Potyrailo, the book series editor, who helped me choose this very intriguing topic on photonic bio/chemical sensing. My gratitude further goes to Dr. Siegfried Janz, Dr. Johannes S. Kanger, and Dr. David Erickson, who kindly provided the nice figures for the book cover and to Dr. Benjamin Eggleton for the foreword.

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