



Understanding Biophotonics: Fundamentals, Advances, and Applications

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Biophotonics involves understanding how light interacts with biological matter, from molecules and cells, to tissues and even whole organisms. Light can be used to probe biomolecular events, such as gene expression and protein–protein interaction, with impressively high sensitivity and specificity. The spatial and temporal distribution of biochemical constituents can also be visualized with light and, thus, the corresponding physiological dynamics in living cells, tissues, and organisms in real time. Light can also be used to alter the properties and behaviors of biological matter, such as to damage cancerous cells by laser surgery or therapy, and manipulate the neuronal signaling in a brain network. Fueled by the innovations in photonic technologies in the past half century, biophotonics continues to play a ubiquitous role in revolutionizing basic life science studies as well as biomedical diagnostics and therapies.

Advancements in biophotonics in the past few decades can be seen not only in biochemistry and cell/molecular biology, but also in numerous preclinical applications. Researchers around the world are searching for ways to bring biophotonic technologies into real clinical practices, particularly cellular and molecular optical imaging. Meanwhile, emerging technologies, such as laser nanosurgery and nanoplasmonics, have created new insights for understanding, monitoring, and even curing diseases on a molecular basis.

This book presents the essential basics of optics and biophotonics to newcomers (senior undergraduates or postgraduate researchers) who are interested in this multidisciplinary research field. With stellar contributions from leading experts, the book highlights the major advancements in preclinical diagnostics using optical microscopy and spectroscopy, including multiphoton microscopy, super-resolution microscopy, and endomicroscopy. It also introduces a number of emerging techniques and toolsets for biophotonics applications, such as nanoplasmonics, microresonators for molecular detection, and subcellular optical nanosurgery.

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