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Preface

As the smart eyes of healthcare professionals and analysts, immunoassays play a prominent role in clinical diagnostics to confirm suspected disease, enabling clinical decisions and subsequent treatments. Ideally, immunoassays must have high detection selectivity and specificity, a high degree of automation, minimal sample treatment, low cost, and fast analysis time. In clinical settings appropriate treatments based on rapid and reliable diagnosis improve patient prognosis and prevent disease spread. Other important applications of immunoassays include veterinary diagnostics, food analysis, environmental monitoring, defense, security, and various bioanalytical settings. To date, immunoassays are available for a plethora of analytes, such as disease biomarkers, pathogens, drug impurities, environmental contaminants, allergens, food adulterants, drugs of abuse, and various biomolecules. Several chapters are devoted to immunoassays for COVID-19, neonatal diseases, HIV, Ebola, biological agents, and botulism.

This book unravels the role and technological evolution of immunoassays in bioanalytical sciences. During the last four decades, immunoassays have been transformed from conventional enzyme-linked immunosorbent assays to more advanced formats, including smartphone-based point-of-care devices. Such advanced formats stem from rapid bioanalytical procedures, novel biosensing schemes, fully integrated lab-on-a-chip platforms, prolonged biomolecular storage strategies, device miniaturization and interfacing, emerging smart system technologies equipped with personalized mobile healthcare tools, and lateral flow immunoassays with various detection schemes with high detection sensitivity. Chemiluminescent tags are conjugated to detect antibodies to greatly simplify the overall operation and shorten the time from sample to result.

Objectives

This book provides comprehensive details of various types of immunoassays that have been performed in healthcare, industrial, environmental, and other bioanalytical settings. The diverse aspects of immunoassays are discussed, including the principles of operation, characteristics, advantages and disadvantages, and potential bioanalytical applications in diverse fields.

Scope

This book outlines various aspects of immunoassays, including antibody/protein immobilization, surface functionalization, point-of-care devices (including lateral flow assays), and regulatory requirements. Multiple types of immunoassays and their bioanalytical performance and characteristics are discussed in detail. It is shown that multiplexing or simultaneous analysis of various biomarkers in a single diagnostic test can be valuable for several diseases. A typical example is neonatal screening for several biomarkers, which may constitute one of 27 treatable disorders.

Target audience

This book aims to provide a thorough understanding and comprehensive view of immunoassays and in vitro diagnostics (IVDs) to healthcare professionals, biomedical engineers/scientists, researchers, healthcare economists, policymakers, investors, professionals in preventive healthcare, and persons interested in personalized healthcare. This book is a useful resource and teaching aid for professionals and researchers in immunoassays, IVDs, biosensors, bioconjugation, biomedical diagnostics, medicine, bioengineering, and multidisciplinary scientific disciplines.

Book organization

This book examines the various immunoassay formats developed to date and discusses various aspects of immunoassays. The first two chapters overview immunoassays, antibody immobilization, and surface functionalization chemistries. The third chapter provides in-depth expert insight into monoclonal antibody generation. The bioanalytical and regulatory requirements for immunoassays are discussed in Chapter 4. Chapters 5–16 discuss the various types of immunoassays developed to date in comprehensive detail. They provide the principles of operation, advantages, potentials, challenges, limitations, bioanalytical applications, and future trends for each immunoassay. The detection platforms are based on enzyme-linked immunoassays, surface plasmon resonance, lateral flow, paper, acoustic waves, interferometry, nano- and micromaterials, microcantilevers, quartz crystal microbalance, electrochemical, lab-on-a-chip technologies, and smartphone readouts. The concluding chapter presents the prospects for immunoassays.

We highly appreciate the efforts devoted by the authors in drafting these outstanding book chapters. The knowledge and insights this book provides on immunoassays will support more efficient healthcare management. It allows for the most comprehensive and updated information about various types of immunoassays and their multiple aspects, including immunoanalytical platforms, systems, and devices. Immunoassays play an instrumental role

in clinical decision-making by rapidly and highly detecting disease biomarkers and analytes. Moreover, they are critically important in the biopharmaceutical industry for manufacturing improved drugs with minor impurities. In addition, they play a prominent role in environmental monitoring. Therefore they form an integral part of the bioanalytical sciences in healthcare, industry, environment, and other fields. The information provided in this book will provide targeted end users with the desired knowledge, competence, and resources related to immunoassays. This will enable targeted users to manage bioanalytical applications and lead to critically improved outcomes in industrial, healthcare, research, and other settings.

The guided insight and knowledge of immunoassays and various aspects of immunoassays provided in this book will be a resource for professionals, researchers, and students who are working or would like to work in the field of bioanalytical sciences.

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