

Preface

The area of microarrays enjoyed unprecedented growth in the last two decades. The early demonstration of the concept in the seminal work of Fodor et al. led to the formulation of new standards for gene expression studies and molecular diagnostics methodologies. The highly parallel microarray concept evolved from the initial area of genomic studies to proteomics and single-cell studies benefiting a multitude of fields from fundamental systems biology to practical diagnostic tests.

In the mid 1980s, dot-blots and slot-blots were utilized in the earliest array experiments. These low-density and early-stage microarrays were used to assess the identity of the material present as well as the concentration of the constituents. Later, they evolved into modern DNA and protein microarrays mostly produced on membranes. In the late 1980s and early 1990s, DNA microarrays were developed further and were either spotted or synthesized via photolithography on solid surfaces. Affymetrix developed photolithography synthesis method into a mature technology and relied upon a step-by-step base synthesis with “photomasks” and light-labile protecting groups on oligonucleotide synthetic blocks. With time, Affymetrix became one of the largest suppliers of commercial DNA microarrays. In parallel, spotting of presynthesized oligonucleotides on the surface, in predetermined two-dimensional patterns allowed for an inexpensive approach to building custom-designed, “home-made” arrays in many research labs.

Nowadays, DNA microarrays have become a widespread tool used in life sciences, drug screening, and diagnostic applications. With the abundant availability of gene targets and combinatorial chemistry/biology libraries, researchers leveraged the ability to study the effects of diseases, environmental factors, drugs, and other treatments on thousands of genes at once using microarrays. DNA microarrays are used in pharmacogenomic studies that include gene expression profiling, the measurement and analysis of regulated genes under various conditions, and genotyping, the detection of polymorphisms or mutations in a gene sequence. DNA microarrays are also useful in molecular diagnostics, which includes genetic screening (e.g., detection of mutations or inherited disorders), identification of pathogens and resistance in infections, and molecular oncology (cancer diagnosis). Protein microarrays, on the other hand, consist of antibodies, proteins, or protein fragments and are used to screen and assess patterns of interaction with samples containing distinct proteins or classes of proteins. Similar to DNA systems developed earlier,

protein microarrays find their use in the identification of diagnostic targets and drug screening. Finally, cell arrays allow for the immobilization of single cells on the solid surface, while maintaining their viability and can be used in ion-channel studies and drug screening experiments as well as in monitored tissue growth.

In this book, not only do we discuss the use of microarrays in DNA studies, but also include peptide arrays, protein arrays, combinatorial chemistry arrays, cell-based arrays, and glycoarrays, to name a few. The book is organized around several features of the microarray field: the biological material studied on the array, the detection methodology, and the application of the array toward specific study or diagnosis of the disease. This organization of the chapters demonstrates the advancement of the field in many different facets and shows the implementation of new technological advances into microarray systems and the subsequent expansion of possible utilization of these systems.

Undoubtedly, we will witness further progress in microarrays due to the introduction of microtechnology, nanotechnology, and modern molecular biology into the field. This book will prove a useful source of current information for researchers in the field of microarrays and for those who are just entering the field of microarray research.

We wish to thank all of the contributing authors for their enthusiasm for the project and their commitment to provide high-quality manuscripts. We are also thankful to our families and coworkers for their patience and support during the course of completing this project.

Kilian Dill
Robin Hui Liu
Piotr Grodzinski

Microarrays

Preparation, Microfluidics, Detection Methods, and
Biological Applications

Dill, K.; Liu, R.; Grodzinsky, P. (Eds.)

2009, XVI, 356 p., Hardcover

ISBN: 978-0-387-72716-5