

Preface

Innovation in the biomedical field is often seen as a critical driver of scientific progress, and a cornerstone of developing modern technology. This has been reflected in the early twenty-first century, as technological developments in biomedicine and biomedical devices have become increasingly prevalent in our hospitals and medical treatments. With the advent of personalized biologics and biomedicine, these advancements are presumed to change our healthcare system entirely. An important aspect of many of these innovations is microfluidic technology, where such devices possess the same size as structures being assayed. Critically, engineers can now create microfluidic devices that possess the precision control required to handle, manipulate, and sort complex biological fluids.

This book contains a collection of chapters intended to highlight, explain, and review the dominant mechanisms that have emerged to manipulate and sort biological structures. Chapter “[Microfluidic cell sorting and separation technology](#)” will provide an overview of the state of the microfluidics field in medicine by highlighting conventional cell sorting techniques, the principles of microfluidics (and establish terminologies and metrics that will be used in the book to assay the performance of devices), and give perspective on future directions for microfluidic devices. The following chapters will cover the dominant mechanisms utilized by microfluidic devices to handle biological samples, including Chapter “[Magnetic Cell Manipulation and Sorting](#)”: magnetism, Chapter “[Electrical Manipulation and Sorting](#)”: electrical, Chapter “[Optical Manipulation of Cells](#)”: optical, Chapter “[Acoustic cell manipulation](#)”: acoustic, Chapter “[Gravity-Driven Fluid Pumping and Cell Manipulation](#)”: gravity/sedimentation, Chapter “[Inertial Microfluidic Cell Separation](#)”: inertial, Chapter “[Microfluidic technologies for deformability based cell sorting](#)”: deformability, and Chapter “[Microfluidic Aqueous Two-Phase Systems](#)”: aqueous two-phase systems. All chapters thoroughly explain the physics of the mechanism at work, review common geometries and devices utilized by engineers/scientists and their accompanying devices, and highlight the benefits and drawbacks of each technique.

This book is intended for use by both graduate-level biomedical engineering and analytical chemistry students as well as engineers/scientists in the biotechnology industry. By organizing the book around dominant physical mechanisms,

explaining these in detail, and covering the state of the art in each respective field, we hope that this book can be a resource for engineers and scientists of all levels. An important theme will be the metrics and capabilities accompanying each technique. For example, one approach may be passive and possess no external driving power, but possess low-throughput and sorting capability. Only by understanding these benefits and drawbacks can engineers decide the type and style of device required for a respective application. The authors believe microfluidics and microtechnologies will continue to play a critical role in biomedicine, and we hope that this book will continue to serve as a resource for this developing field.

We finally thank all the authors for their time and effort in writing their respective chapters.

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