

Preface

‘Microfluidic Technologies for Miniaturized Analysis Systems’ – Is a further book in the field of Lab-on-a-Chip technology needed? Yes, we think so! Sure, the area is already covered by a considerable number of review articles, contributed articles and monographs. Yet, microfluidics and Lab-on-a-Chip technology are fast developing branches of research and technology, so in principle there is a continuous demand for reviews covering the latest results. However, after being exposed to our book we hope that the reader is convinced that there is more than only this aspect that distinguishes it from other publications in the field.

A Lab-on-a-Chip is usually a highly heterogeneous object, requiring the interplay of a number of different disciplines such as microfluidics, bioanalytics, or microfabrication. The first Lab-on-a-Chip systems have emerged in the beginning of the 1990s, to a considerable extent spurred by the progress in microfabrication technology previously made. By now the field has reached a certain degree of maturity, reflected by the large number of bioanalytical assays that have been implemented on Lab-on-a-Chip platforms, the large number of competing technological solutions that have been presented, and the increasing number of economic aspects being taken into account when developing corresponding systems. However, the technology’s economic success still falls short of the expectations that have been formulated about ten years ago. The reasons for this mismatch are probably rather complex and diverse and are not to be analyzed here. One possible and very straightforward reason might be that the bar for economic success had been raised unrealistically high. We hope that, if only to a modest degree, this book may also help to bridge the gap between scientific ideas and their economic implementation.

In any case, the recent rapid development in Lab-on-a-Chip technology is closely related to progress in microfluidics, being the art of handling fluids and controlling flow in microscale geometries. As often, the economic prospects of a new, emerging technology also drives related areas of fundamental research. In the case of microflow fundamentals, a large number of relevant and important new results have been obtained in the past few years. This development should not let us forget the foundations of microfluidics that have been laid in the late 19th and early 20th century. Already Maxwell, von Smoluchowski and Knudsen have obtained key results for gas flow in small channels. Another area highly relevant to

microfluidics are flows with moving interfaces, for which Washburn and Lucas published some pioneering papers in the early 20th century.

The purpose of this volume is to illuminate the microfluidics side of Lab-on-a-Chip technology in detail. The techniques, methods and effects employed to control and handle fluids in microscale geometries described in the literature constitute a kind of “toolbox”. In the early years this toolbox was relatively sparsely equipped and the situation could be characterized by the poor craftsman’s slogan ‘If your only tool is a hammer every problem looks like a nail’, meaning that appropriate miniaturized solutions were not at hand in many cases. By contrast, nowadays a large portfolio of microfluidic technologies does exist. A Lab-on-a-Chip designer is usually spoilt for choice when it comes to deciding which tool to use to solve his problem.

This book describes many of the most important constituents of the microfluidic technology toolbox. In this regard it is different from most other books covering Lab-on-a-Chip technology which give a *complete* overview of the field including microfabrication, biosensor technology, and packaging. As always, there is a tradeoff between broadness and depth, and in many works the key microfluidic technologies are only covered in a rather superficial manner. By contrast, in the following chapters a detailed account of the microfluidic working principles of Lab-on-a-Chip systems is given, thereby sacrificing other areas such as microfabrication or biosensor technology. We believe that an in-detail coverage is justified as an area grows more mature, going along with an increasing demand for comprehensive, in-depth information rather than overview-style writing. The preferred format for such a project is an edited book, guaranteeing that the know-how pool of the contributing authors by far exceeds the knowledge of a few authors who could possibly set up a monograph in the same field.

The chapters of this volume were written by international experts in Lab-on-a-Chip technology or related areas, each of them covering a specific constituent of the microfluidic technology toolbox. As already mentioned, we regard the in-depth coverage of the different topics a key aspect of the project. Furthermore, it is still important that each chapter gives an overview of the state-of-the-art in the corresponding field. This was taken care of by including a large number of references, thereby informing the reader where further information can be found. Even in the age of internet search engines and databases it is sometimes difficult to find every relevant article on a specific topic, especially in such an interdisciplinary field as Lab-on-a-Chip technology. Therefore we hope that the reader may find the extensive and up-to-date literature lists at the end of most chapters helpful.



<http://www.springer.com/978-0-387-28597-9>

Microfluidic Technologies for Miniaturized Analysis
Systems

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2007, XXI, 616 p., Hardcover

ISBN: 978-0-387-28597-9