Preface

Biosciences and material sciences emerged initially as distinct disciplines. However, recent progresses in polymer and material sciences led to congruent research interests, thus fusing the fields of material and biosciences progressively. To concretize visionary ideas such as adaptive bio-host systems, bio-instructive materials, bio-integrated functional systems, or regenerative tissue engineering, the interfaces between synthetic materials and biological systems have been identified as one key issue. The present volume of *Advances in Polymer Science* covers the most important aspects of the emerging area of "Bioactive Surfaces." Selected experts in the field of polymer science, soft-matter engineering, and biophysics have been invited to highlight their personal views and perspectives on this crucial field of research.

Even though molecular biologists developed lately precise analytical tools of genomics, regulomics, and proteomics, allowing for progressively accurate insight into systemic functions of cells and tissues, the interfaces between synthetic materials and biological systems are still far from being fundamentally understood. In the last decade, joint multidisciplinary efforts and intense exchange between the biology and materials research communities set the focus on signaling of materials toward biological systems. Cells or cell populations at a bio-material interface experience a broad spectrum of chemo-, mechano- physico-, and topological signals, which are interpreted by the biosystem. This triggers distinct responses, which often occur on all functional bio-hierarchy levels from altering cell metabolism to changing cell status, regulating cell proliferation, differentiation or motility to macroscopic changes of the cell shape, orientation, migration, or adhesion behavior. Fundamental understanding of the events and responses paves the way to actively communicate with biological systems via the material-interface to influence, guide, or direct cells and tissues. This promises enormous progress for life science applications, however, puts challenges on materials design and accurate fabrication, as precisely tailored materials and interfaces are mandatory.

In this exciting context, this volume provides a broad overview on the field of synthetic biologically active surfaces. In particular, three important aspects are emphasized in this volume: (1) surface design, (2) interactions of 2D and 3D surfaces with biosystems, and (3) applications. Regarding surface preparation and modification, the reader will find in this book a practical description of synthetic tools, which constitute the state of the art in the field. For instance, surface functionalization

strategies, using responsive polymer brushes (Chap. 1), peptide arrays (Chap. 2), self-assembled monolayers (Chap. 4), or polyelectrolyte multilayers (Chap. 5), are described in this volume. The middle section of this book (i.e. Chaps. 3–6) describes principally the interactions of 2D and 3D surfaces with biological systems. For instance, important topics such as surface nanostructuration (Chap. 3), the fabrication of micro-reservoirs (Chap. 5), and the preparation and processing of active 3D scaffolds (Chap. 6) are specifically addressed in this volume. Furthermore, practical applications of synthetic bioactive surfaces are described throughout the book. In particular, concrete examples of applications in research fields as diverse as tissue engineering, drug delivery, biochips, biosensors, bioseparation, cell engineering, stem-cell differentiation, and antimicrobial surfaces are discussed in this volume.

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