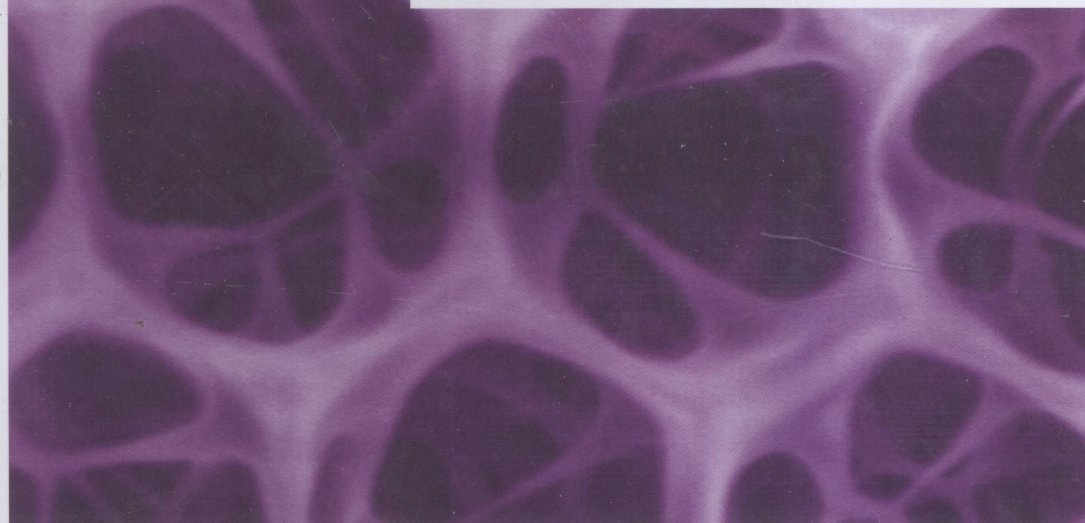
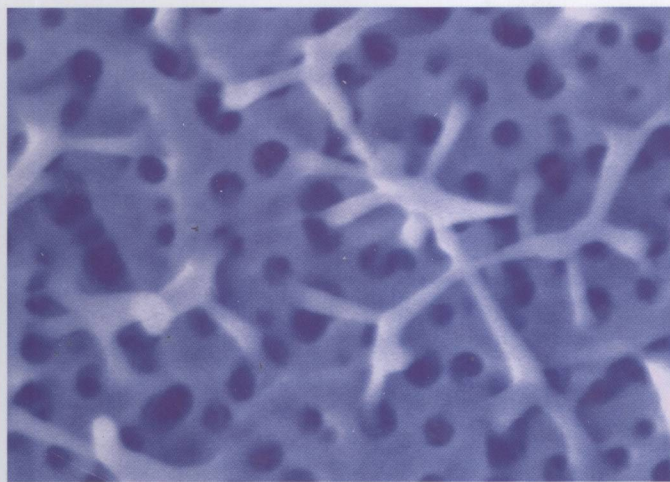
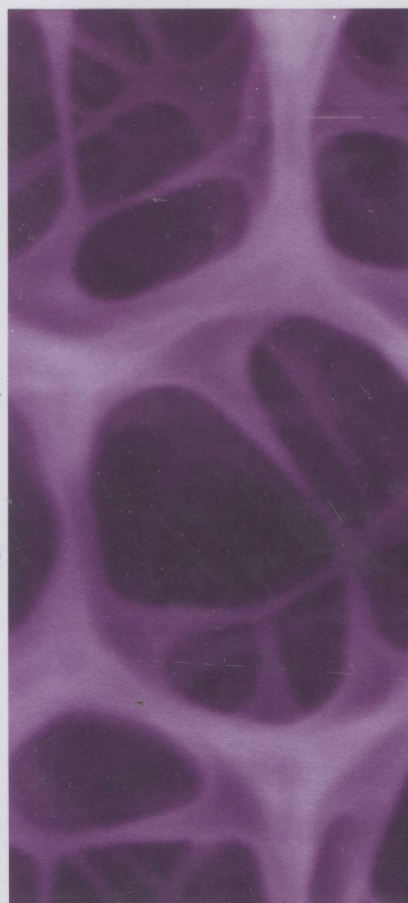


Edited by R. Förch, H. Schönherr,  
and A. T. A. Jenkins

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# Surface Design: Applications in Bioscience and Nanotechnology



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# **Surface Design: Applications in Bioscience and Nanotechnology**

*Edited by  
Renate Förch, Holger Schönherr,  
and A. Tobias A. Jenkins*



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## Foreword

Thomas S. Kuhn's theory of scientific revolution became a landmark in the intellectual history of the twentieth century. He wrote in his 1962 book *'The Structure of Scientific Revolutions'* that science was not a steady, cumulative acquisition of facts and knowledge but rather 'a series of peaceful interludes punctuated by intellectually violent revolutions.' During those revolutions, he wrote, 'one conceptual world view is replaced by another' and this takes place when, within the hereto existing paradigms, scientists cannot account for new findings any longer. Such paradigm shifts, as it has been suggested, are currently underway in polymer science. On the foundations of polymer science new fields like macromolecular nanotechnology, and biomacromolecular science are emerging and the rapidly changing intellectual circumstances and technical possibilities are rewriting the science of soft matter. This volume is a typical product reflecting this changing scientific landscape and paradigm shift.

In 1998, facilitated by a joint Ph.D. student, we decided that we should have joint 2–3-day long group work meetings to take place, alternately, in Mainz at the Max Planck Institute for Polymer Research (MPI), and in Enschede, in the Netherlands, at the University of Twente, recently in the MESA<sup>+</sup> Institute for Nanotechnology. To date, another eleven meetings followed this first one, more or less on an annual basis. With the appointment of Toby Jenkins at the University of Bath the originally bipolar venue became a triangle and the Mainz–Twente–Bath workshop series, or MTB Seminars as we call them today, was born. The lectures are usually offered by graduate students and postdoctoral scientists, and we occasionally combine these with guest lectures offered by more senior colleagues who just happened to be around visiting, or were encouraged to join from other groups. These 'guest' groups initially included the departments of David Reinhoudt and Jan Feijen from Twente. Beyond the reach of bureaucrats (we have never received any funding to finance the costs, which were always covered by our regular research grants, ensuring intellectual independence) a tremendous, dynamic and intellectually highly challenging discussion seminar series was born, which combined the more fundamental surface–biointerface interests of the Knoll group at MPI with the 'midstream' platform work of the Vancso group backed up by engineering in MESA<sup>+</sup> and the biologically tinted work of the Jenkins group in Bath.

As this seminar series, in a way, paralleled the paradigm shift in polymer science, we all thought that it would be useful to share some major topics in the form of a book with interested readers.

Once asked what would be the most fitting name for the MTB series, Toby Jenkins' immediate reply was: 'Designer Surfaces', which certainly influenced the title of this monograph. In this volume the reader finds a collection of chapters in which we give a representative account of the topics covered during MTB meetings in their most recent 'editions'. We believe that these chapters should be useful for all those readers, who are interested in receiving a (somewhat biased) cross-section of the field of 'surface design and engineering' primarily for biomaterial and life-science applications. We complemented the book with tutorial reviews focusing on selected fundamentals that – we all believe – would be useful to follow the more specialized chapters and may help graduate students and newcomers to this field. The tutorial section is followed by four blocks of chapters. First, designer concepts of functional, engineered polymer surfaces and interfaces as platforms are described; and on this basis, via selected representative examples, their applications in sensing are treated. The next block deals with nanoparticles and containers, which can be conceptually considered as efforts aimed at engineering soft matter towards the third dimension, from surfaces via interfaces, towards a full three-dimensional (3D) control. Current interest focuses on the design, fabrication and applications of full 3D systems and it is a cliché to say that the development of this area is still in its early stages. All these topics would be unimaginable without sophisticated tools like scanning probe microscopy and plasmonic devices; hence the last block of chapters is devoted to analysis techniques. The book is then completed with a glossary of surface analytical tools.

We can ask ourselves what might we expect in the future? Looking forward, the possibilities are tremendous. We expect scientific progress in areas like solving the protein-folding problem, providing designer principles for artificial-biological interphases with controlled protein fouling, scaffolds for tissue engineering, and concepts for assembling working machines powered and controlled by molecular motors. We expect to make progress towards the full control of three-dimensional functional designer structures. These should exhibit a carefully assembled structural architecture to serve functions in devices like ultrafast molecular computing, photonics, and sensing; in (nano)medicine and biomaterials, foodstuff, and energy production. Of course, this list is by no means complete. We will look at Nature for inspiration, and for guiding principles as we proceed along this road, satisfying our scientific curiosity and providing things for use.

It is a great pleasure to close this foreword with some acknowledgements. Of course, our contributions to the MTB seminars and to this book have been primarily facilitating, encouraging, providing the logistics, and perhaps here and there steering the discussions. We have always strongly emphasized the importance of interactions among graduate students and young scientists, and never begrudged any support, financial or other, for mutual visits and joint experiments. After all, success and progress depends on those who do the work, that is, on our graduate students and postdocs. Results of these collaborations are described in countless

joint papers. New friendships were born, and old ones became stronger during the social parts of the MTB seminars, which took place in boats on the River Avon in Bath, during bowling and barbecues in Twente, in British pubs and bars, in 'Bierhallen' in Mainz and in castles along the Rhein river. This has been a great time and we look forward to the continuation. Due to changes in personal circumstances venues and participating parties may change but there is one thing for sure that will not change, that is our enthusiasm and support for this seminar series.

The book the reader holds in his/her hands would not have been possible without the tireless and great contributions of the three editors, Renate Förch from Mainz, Holger Schönherr from Twente, and Toby Jenkins from Bath. Renate, Holger, Toby, thank you very much.

*Wolfgang Knoll  
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