Preface

A promising approach and ongoing challenge in macromolecular science exploits the formation of complex ordered structures by (macro)molecular self-assembly. The various examples of biomacromolecules in nature impressively demonstrate how a well-defined primary molecular structure can lead to a rich complexity of structure and function on a hierarchy of different length scales. Our growing ability to control molecular structures in synthetic macromolecules opens new pathways toward novel complex macromolecular architectures, where hierarchical organization and long-range interactions enable to design new functions and tailor physical and chemical properties. The combination and interplay of these well-balanced "internal fields" with "external fields" such as mechanical, electrical, magnetic, electromagnetic, and/or the interactions with surfaces are a powerful tool to create defect-free and perfectly ordered macromolecular structures on a macroscopic scale, leading to new material properties, processes, and applications.

Therefore, the scientific understanding, control and manipulation of macromolecules, and the implementation in devices and applications of higher complexity are of critical importance for advances and breakthroughs of emerging technologies. Complex macromolecular systems play a key role in technology areas such as the generation, conversion, storage, and conservation of energy, organic electronics, photonics, information storage, and communication and display technology.

Within this context, the German Research Foundation (Deutsche Forschungsgemeinschaft) established in 1998 at the University of Bayreuth the Collaborative Research Centre (Sonderforschungsbereich) SFB 481 on *Complex Macromolecular and Hybrid Systems in Internal and External Fields*. The basis for this Collaborative Research Centre was the long-term interdisciplinary research focus on "Macromolecular and Colloid Research" at the University of Bayreuth. This focus included research groups from macromolecular chemistry, physical chemistry, experimental physics, theoretical physics, and materials science & engineering. After a maximal funding period of 12 years, members of SFB 481 now present highlights of their scientific achievements in the form of review articles in Volumes 227 and 228 of *Advances in Polymer Science*.

The first volume contains review articles on electric field-induced effects on block copolymer microdomains (by H. Schoberth, V. Olszowka, K. Schmidt, and A. Böker); on experiments and simulations of the nanopattern evolution in block copolymer thin films (by L. Tsarkova, G.J.A. Sevink, and G. Krausch); on non-lithographic approaches for topographical structuring of polymer surfaces utilizing external mechanical fields and buckling instabilities (by A. Schweikart, A. Horn, A. Böker, and A. Fery); on a generalization of the usual hydrodynamic description of destabilization and reorientation of layered systems under shear flow (by D. Svenšek and H.R. Brand); on the thermal diffusion in polymer blends, focusing on experimental and theoretical investigations on the patterning and structure formation processes (by W. Köhler, W. Zimmermann, and A. Krekhov); and on foaming of polymer blends, microstructured and nanostructured by triblock terpolymers (by H. Ruckdäschel, P. Gutmann, V. Altstädt, H. Schmalz, and A.H.E. Müller).

The second volume provides review articles on recent advances in polyelectrolyte stars and cylindrical brushes (by Y. Xu, F. Plamper, M. Ballauff, and A.H.E. Müller); on various aspects of interfacial self-assembly of nanoparticles in liquid–liquid interfaces and in block copolymers (by N. Popp, S. Kutuzov, and A. Böker); on the materials development and photophysics of azobenzene-containing block copolymers as potential media for reversible volume holographic data storage and azobenzene-containing molecular glasses for the controlled formation of surface relief gratings (by H. Audorff, K. Kreger, R. Walker, D. Haarer, L. Kador, and H.-W. Schmidt); on donor–acceptor block copolymers with nanoscale morphology for photovoltaic applications (by M. Sommer, S. Hüttner, and M. Thelakkat); and on recent advances in the improvement of polymer electret films with potential applications in microphones, sensor devices, electret filters, and in energy-harvesting devices (by D.P. Erhard, D. Lovera, C. von Salis-Soglio, R. Giesa, V. Altstädt, and H.-W. Schmidt).

On behalf of all members of the Collaborative Research Centre 481 on *Complex Macromolecular and Hybrid Systems in Internal and External Fields*, we wish to thank the Deutsche Forschungsgemeinschaft for financial and administrative support, the voluntary reviewers of the proposals for their invaluable judgment and advice, the Bavarian State Ministry of Sciences, Research and the Arts, and the University of Bayreuth for their ongoing support to continuously develop and strengthen the interdisciplinary research focus on "Macromolecular and Colloid Research" at the University of Bayreuth. Undoubtedly, all of these measures helped to advance the impact and international visibility.

Bayreuth, April 2010 *Hans-Werner Schmidt*
Axel Müller

The authors would like to dedicate these two volumes of Advances in Polymer Science to their colleagues and friends, Prof. Raimund Stadler and Prof. Lorenz Kramer, members of this Collaborative Research Centre, who passed away much too early. Their scientific vision and inspiring research had a great impact on progress and success of this Collaborative Research Centre.

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