Basic coarse-grained models describing the statistical properties of macromolecules in solution and melts were introduced by Flory, Stockmayer, and others a long time ago. Shortly after the introduction of the Metropolis importance sampling method (1953), as a tool for the statistical mechanics of fluids, the first simulation studies of the excluded-volume problem began (Rosenbluth and Rosenbluth's [1955] ''inversely restricted sampling'' of self-avoiding walks on lattices). However, it only happened during about the last 25 years that we see an explosive growth of work, both by analytic methods and by computer simulation. The groups from Moscow and St. Petersburg on the Russian side, and groups originating to some extent in the condensed matter theory group of the University at Mainz in Germany, have been at the forefront of many of these exciting developments for a long time. For instance, groups in Russia have made seminal contributions to the theory of the collapse transition of isolated polymer chains, to the weak and strong segregation limits of order-disorder phenomena in copolymer systems, and to the theoretical understanding of polymer brushes. Likewise, the German groups have pioneered the development of Monte Carlo and Molecular Dynamics simulation methods on these subjects, including also studies of famous problems such as ''Do polymer chains reptate?'', and critical phenomena of many-chain systems beyond mean field theories, for instance.

Since about 15 years, the mentioned groups have ''joined forces'', and a very intensive and fruitful scientific exchange has begun. In the framework of this collaboration (which was supported by the German National Science Foundation [DFG], Max- Planck Society, the Alexander von Humboldt-Foundation, INTAS, the Russian Foundation for Basic Research, etc.) diploma students, Ph.D. students and postdoctoral researchers have been exchanged, joint meetings were held, and research projects coordinated. In this way, pioneering research on the forefront of polymer science could be conducted, as is also evident from the present proceedings of an international workshop held at the Physics Department of Moscow State University from June 6 - 11, 2006, sponsored mostly by the projects DFG 436 RUS/113/791 and RFBR 06-03-04000, organized by A.Khokhlov (Chairman), K. Binder (Co-Chairman), V.Ivanov, W.Paul and J.Martemyanova (Scientific Secretary). This workshop, containing 24 invited and 7 contributed oral presentations, as well as 21 posters, with participants not only from Russia and Germany, but also from France, England, and Canada, gave an excellent overview of recent results and current research trends in the field. The present proceedings contain a selection of 15 highlights from this symposium. The presented papers focus both on recent advances in the simulation methodology of macromolecules (e.g. via application of the Wang-Landau and PERM algorithms) and accompanying progress in the analytical theory, giving thus evidence for the improved understanding of structure and dynamics of complex polymeric systems. This includes new insight on the dense state of both flexible homopolymers (see the paper by Paul et al.) and stiff chains (paper by Ivanov and Martemyanova) and stiff amphiphilic molecules (paper by Markov et al.). A particular focus was also the statistical mechanics of polymer brushes (papers by Dimitrov et al., Hsu et al., and Mercurieva et al.). Copolymers were another topic that found widespread attention (papers by Khalatur and Khokhlov, Mller and Daoulas, and Kuchanov), as well as various macromolecular aggregates (papers by Neelov at al., and Tsekov and Vinogradova). Liquid crystalline polymers were considered by Schmid at al. and by Darinskii et al. Very interesting progress on the hierarchical modeling of entangled polymers can be found in the paper by Ramirez et al., while Gotlib et al. discuss the viscoelasticity of polymer networks with embedded rod-like particles. This brief overview both indicates the wide range of problems that were addressed, and gives evidence that the statistical mechanics of polymeric systems is a very active and rapidly developing field.

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