Preface

The classical view on polymer crystallization basically focused on the explanation of a few macroscopically observable parameters like the thickness of the resulting lamellar structure and the corresponding growth rates. However, the emerging paradigm for the description of chain crystals is too simple and cannot account for the complex non-equilibrium processes responsible for structure formation on various levels, ranging from the nanometer up to the millimeter scale. This complexity detected by several novel experimental results led to a renewed interest in this "old" topic of polymer crystallization. These new findings concern the early stages of the crystallization process, crystal formation in confined geometries like ultra-thin films and the competition between (micro)phase separation and crystallization in copolymers and blends. In particular, high spatial resolution techniques such as atomic force microscopy provided deeper insight into the molecular organization of crystallizable polymers. Computer simulations based on microscopic processes were used to improve our understanding of how polymer crystals are nucleated and how they grow. New ideas emerged about possible multistage pathways which are followed during the formation of polymer lamellae. The importance and the consequences of the non-equilibrium character of polymer crystals got significantly more attention. Links and analogies to growth phenomena and pattern formation in general are being developed. However, these ideas are still subject of intensive and controversial discussions. As a result of these discussions, a number of novel experiments and computer simulations have been designed with the aim to discriminate between the underlying basic assumptions. Obviously, this present situation needs a common platform, which is the aim of this volume of "Lecture Notes in Physics".

We tried to assemble a collection of novel experimental results and theoretical concepts reflecting the state-of-the-art in polymer crystallization. This comprises phenomena at the onset of crystallization, kinetically controlled growth and subsequent relaxation, responsible for the formation of complex structures with order on several length-scales. Although the content of this volume is already rather substantial, we do not want to pretend that all aspects and new results currently under consideration are included. Nevertheless, it provides a broad overview of the ongoing research on the subject of polymer crystallization to readers with a general background in polymer physics as well as to experts in this field.

Although this book cannot give definite answers to many questions still controversially discussed, it may stimulate new works and attempts shedding more light on these problems. The new results also demand profound revisions of the existing theoretical models and ask for a new conceptual understanding of polymer crystallization as a non-equilibrium process.

We hope that such a collective endeavour will help to advance our understanding of polymer crystallization!

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