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.
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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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Jens-Uwe Sommer
Günter Reiter
List of Contributors

Mahmoud Al-Hussein
Albert-Ludwigs-Universität,
Fakultät für Physik,
Hermann-Herder-Str. 3
79104 Freiburg, Germany

Hans-Georg Braun
Max Bergmann Center for Biomaterials and
Institute of Polymer Research
Dresden,
Microstructure Group,
01069 Dresden, Germany

Gilles Castelein
Institut de Chimie des Surfaces et Interfaces CNRS
et Université de Haute Alsace,
Mulhouse, 15 rue Jean Starcky,
68057 Mulhouse, France

Wim H. de Jeu
FOM-Institute for Atomic and Molecular Physics,
Kruislaan 407,
1098 SJ Amsterdam, The Netherlands

Gaetano Di Marco
C.N.R.,
Istituto per i Processi Chimico–Fisici, sez. Messina,
Via La Farina 237,
98123 Messina, Italy

Tiberio A. Ezquerra Sanz
Instituto de Estructura de la Materia, C.S.I.C.,
Serrano 119,
Madrid 28006, Spain

Jamie K. Hobbs
H.H. Wills Physics Laboratory,
Tyndall Avenue,
Bristol BS81TL, UK

Dimitri A. Ivanov
Laboratoire de Physique des Polymères,
Université Libre de Bruxelles,
CP223, Boulevard du Triomphe,
B-1050
Brussels, Belgium

Bernd-J. Jungnickel
Deutsches Kunststoff-Institut,
Schlossgartenstr. 6,
64289 Darmstadt, Germany

Zebene Kiflie
Università di Palermo,
Dipartimento di Ingegneria Chimica,
Viale delle Scienze,
90128 Palermo, Italy

Tsunehisa Kimura
Tokyo Metropolitan University,
Department of Applied Chemistry,
1-1 Minami-ohsawa, Hachoiji,
Tokyo 192–0397, Japan

Sergei N. Magonov
Digital Instruments/Veeco Metrology Group,
112 Robin Hill Rd.,
Santa Barbara, CA 93117, U.S.A.
XVI  List of Contributors

Evelyn Meyer
Max Bergmann Center
for Biomaterials and
Institute of Polymer Research
Dresden,
Microstructure Group,
D-01069 Dresden, Germany

Hendrik Meyer
Institut Charles Sadron, CNRS,
6, rue Boussingault,
67083 Strasbourg, France

Alaa Mohammed
University of Rostock,
Department of Physics,
18051 Rostock, Germany

Aurora Nogales Ruiz
University of Reading,
J.J. Thomson Physics Laboratory,
Witheknights,
Reading RG6 6AF, U.K.

Norimasa Okui
Tokyo Institute of Technology,
Department of Organic and Polymeric Materials,
International Research Center of Macromolecular Science,
Ookayama, Meguroku, Tokyo, Japan

Gerrit W.M. Peters
Eindhoven University of Technology,
Materials Technology
(www.mate.tue.nl),
Dutch Polymer Institute,
P.O. Box 513,
5600 MB Eindhoven, The Netherlands

Stefano Piccarolo
Università di Palermo,
Dipartimento di Ingegneria Chimica,
Viale delle Scienze,
90128 Palermo, Italy

Marco Pieruccini
C.N.R.,
Istituto per i Processi Chimico–Fisici,
sez. Messina,
Via La Farina 237,
98123 Messina, Italy

Sanjay Rastogi
Department of Chemical Engineering/Dutch Polymer Institute,
P.O.Box 513,
5600 MB Eindhoven, The Netherlands

Günter Reiter
Institut de Chimie des Surfaces et Interfaces CNRS
et Université de Haute Alsace,
Mulhouse, 15 rue Jean Starcky,
68057 Mulhouse, France

Jens Rieger
BASF Aktiengesellschaft,
Polymer Physics,
67056 Ludwigshafen, Germany

Christoph Schick
University of Rostock,
Department of Physics,
18051 Rostock, Germany

Jens-Uwe Sommer
Institut de Chimie des Surfaces et Interfaces CNRS
et Université de Haute Alsace,
Mulhouse, 15 rue Jean Starcky,
68057 Mulhouse, France

Gert Strobl
Albert-Ludwigs-Universität,
Fakultät für Physik,
Hermann-Herder-Str. 3
79104 Freiburg, Germany

Joan Josep Suñol
Universitat de Girona,
Grup de Recerca en Materials i Termodinàmica,
17071 Girona, Spain
Susumu Umemoto  
Tokyo Institute of Technology,  
Department of Organic and Polymeric Materials,  
International Research Center of Macromolecular Science,  
Ookayama, Meguroku, Tokyo, Japan

Mingtai Wang  
Max Bergmann Center for Biomaterials and  
Institute of Polymer Research Dresden,  
Microstructure Group,  
01069 Dresden, Germany

Elena Vassileva  
Universität Kaiserslautern,  
Institut für Verbundwerkstoffe GmbH,  
Erwin Schrödingerstrasse Geb.58,  
67663 Kaiserslautern, Germany

Andreas Wurm  
University of Rostock,  
Department of Physics,  
18051 Rostock, Germany
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