

POLYMER LIQUID CRYSTALS SERIES ②

# RHEOLOGY AND PROCESSING OF LIQUID CRYSTAL POLYMERS

*edited by*  
D. ACIERNO and A. A. COLLYER



CHAPMAN & HALL

# Rheology And Processing Of Liquid Crystal Polymers

**Francesco Paolo La Mantia**



## **Rheology And Processing Of Liquid Crystal Polymers:**

**Rheology and Processing of Liquid Crystal Polymers** Domenico Acierno,A.A. Collyer,2013-11-27 Liquid crystal polymers LCPs have many strange properties that may be utilized to advantage in the processing of products made from them and their blends with isotropic polymers This volume volume 2 in the series Polymer Liquid Crystals deals with their strange flow behaviour and the models put forward to explain the phenomena that occur in such polymers and their blends It has been known for some time that small additions of a thermotropic LCP to isotropic polymers not only gives an improvement in the strength and stiffness of the blend but improves the processability of the blend over that of the isotropic polymer In the case of lyotropic LCPs it is possible to create a molecular composite in which the reinforcement of an isotropic polymer is achieved at a molecular level by the addition of the LCP in a common solvent If the phenomena can be fully understood both the reinforcement and an increase in the processability of isotropic polymers could be optimized This book is intended to illustrate the current theories associated with the flow of LCPs and their blends in the hope that such an optimization will be achieved by future research Chapter 1 introduces the subject of LCPs and describes the terminology used Chapter 2 then discusses the more complex phenomena associated with these materials In Chapter 3 the way in which these phenomena may be modelled using hamiltonians is fully covered

*Processing and Properties of Liquid Crystalline Polymers and LCP Based Blends* Domenico Acierno,Francesco Paolo La Mantia,1993 Some papers in this book report on the most recent developments in pure liquid crystalline polymers showing that discipline is dynamic and may offer in the future numerous other opportunities not known today We hope that our selections of papers will be interesting for specialists in polymer chemistry blends and their industrial application and that information included in this book will be stimulating and will favorably impact research currently performed by the readers of this book

**Liquid Crystal Polymers** D. Coates,2000 Liquid crystal polymers LCPs have a wide range of uses from strong engineering plastics to delicate gels for use in liquid crystal LC displays For this reason it is essential reading for materials scientists engineers or technologists in industry as well as research laboratories or academia An additional indexed section containing several hundred abstracts from the Rapra Polymer Library database gives useful references for further reading

**Rheology & Processing of Liquid Crystal Polymers** D Ed Acierno,Collyer A A Ed,1996

**Thermotropic Liquid Crystal Polymers** Tai-Shung Chung,2001-03-01 Liquid crystal polymers are sometimes called super polymers with good reason Their wide range of exceptional properties and ease of processing make them design candidates for many demanding applications This new book provides a thorough review of LCP technology with the emphasis on the chemistry synthesis and characterization of the material in its many variants Additional chapters cover processing and applications From the Editor's Preface The field of thermotropic liquid crystalline polymers has grown substantially in the last two decades with fundamental research publications commercial products and patents In the 1980's Dr Ralph Miano led my colleagues and me at Hoechst Celanese in commercializing the

first thermotropic liquid crystalline polymers based on Dr Gordon Calundann's composition patents. Today more than seven companies have produced thermotropic liquid crystalline polymer materials with at least 50 variants available. Hence it is timely to compile a comprehensive review on the nature of this type of material and the ongoing progress in this field. The goals of this book are to summarize previous work, provide new insights into this class of polymers, and add to the understanding of the formation of liquid crystallinity. This book covers a wide range of topics and addresses different disciplines in the field. The chapters are arranged as a learning scheme for the professional from basic science to applied engineering. The first few chapters summarize the syntheses of various polyester, polyester amide, and polyimide liquid crystalline polymers. The science and origins of liquid crystal formation are revealed. Next, we introduce the characterizations of these materials by their different chemical and physical aspects. Because most commercially available thermotropic liquid crystalline polymers have been used in the form of composites, we have also incorporated a chapter on polymer blends detailing blending mechanisms and resultant properties. Two chapters on thermosetting liquid crystalline polymers integrate them with other topics because of their unique importance and their applications for microelectronics and packaging. The final chapter deals with the engineering and processing aspects of thermoplastic liquid crystalline polymers for a variety of applications.

**Rheology and Processing of Liquid Polymers** D. Acierno, A. A. Collyer, 1996

**Liquid Crystalline Polymers** A. M. Donald, A. H. Windle, S. Hanna, 2006-05-11. A 2006 edition explaining the underlying science and applications of liquid crystalline polymers.

*Liquid Crystalline Polymers* Vijay Kumar Thakur, Michael R. Kessler, 2015-11-16. This book introduces anisotropic innovations in liquid crystalline polymers as well as new nanocomposite materials and testing techniques. The authors detail the newest discoveries of material properties, material types and phases, and material characterization. This interdisciplinary work creates valuable links that strengthen the approach to the evolving field of liquid crystalline polymers materials.

**Handbook of Liquid Crystals—Volume I** Shri Singh, 2024-02-24. This expert and self-contained authored handbook provides comprehensive coverage of liquid crystals from the fundamental materials science, physics, and modeling through cutting edge applications. Written by an author with over 40 years of active experience in this growing field, it offers an unprecedented self-contained treatment of this key research area. Liquid crystals are a state of matter sharing properties that are usually associated with both solids and liquids. Their study belongs to a wider field of soft condensed matter physics, an area growing in importance because of the new physics being discovered and the possibilities of various technological applications being developed. Liquid crystals continue to have a revolutionary technological impact and consistently pose new challenges of basic understanding. While the experimental side of liquid crystal research is very well developed, theoretical understanding has lagged, and this volume fills a gap in the published literature in terms of rigorous treatment of mathematical and computer modeling approaches. Volume I of this handbook deals with the physical foundations and fundamental aspects of liquid crystals, addressing their physical properties, measurement techniques, and

various types Overall this handbook serves as the ultimate scholarly guide for researchers scientists and engineers seeking to unlock the full potential of liquid crystals It offers a comprehensive understanding of these materials and their diverse applications empowering readers to navigate the complex intricacies of liquid crystal science and technology

**Mechanical and Thermophysical Properties of Polymer Liquid Crystals** Witold Brostow, 2013-11-27 may never overcome the effects of hysteresis and stress see Chapters 6 and 12 The first sentence of the reference work Handbook of Liquid Crystals reads The terms liquid crystals crystalline liquid mesophase and mesomorphous state are used synonymously to describe a state of aggregation that exhibits a molecular order in a size range similar to that of a crystal but acts more or less as a viscous liquid 2 In other words molecules within a liquid crystalline phase possess some orientational order and lack positional order furthermore the shape of a liquid crystalline sample is determined by the vessel in which it is contained rather than by the orientational order of its aggregated molecules The authors recognized the limitations and imprecision of this definition but like others preceding them could not devise a simple and generally applicable one that is better Regardless the terms liquid crystal and mesophase should not be used interchangeably As mentioned above all liquid crystals are mesophases but all mesophases are not liquid crystals Recent studies employing elaborate and sophisticated analytical techniques have permitted finer distinctions between classical crystals and mesophases At the same time they have made definitions like that from the Handbook of Liquid Crystals somewhat obsolete for reasons other than terminology One part of the problem arises from the use of a combination of bulk properties like flow and microscopic properties like molecular ordering within the same definition

**High Temperature Polymer Blends** Mark T. DeMeuse, 2014-03-25 Polymer blends offer properties not easily obtained through the use of a single polymer including the ability to withstand high temperatures High Temperature Polymer Blends outlines the characteristics developments and use of high temperature polymer blends The first chapter introduces high temperature polymer blends their general principles and thermodynamics Further chapters go on to deal with the characterization of high temperature polymer blends for specific uses such as fuel cells and aerospace applications The book discusses different types of high temperature polymer blends including liquid crystal polymers polysulfones and polybenzimidazole polymer blends and their commercial applications High Temperature Polymer Blends provides a key reference for material scientists polymer scientists chemists and plastic engineers as well as academics in these fields Reviews characterization methods and analysis of the thermodynamic properties of high temperature polymer blends Reviews the use of materials such as liquid crystals as reinforcements as well as applications in such areas as energy and aerospace engineering

**Thermotropic Liquid Crystal Polymer Blends** Francesco Paolo La Mantia, 1993-12-04 In recent years studies by both industry and academic researchers have opened the door to improving performance and reducing costs of these new materials The particular structure and morphology of LCPs as well as their peculiar rheological behavior have stimulated researchers to develop new theoretical models and new characterization and processing techniques

to more fully understand and utilize LCPs Although the scientific literature is very rich in data on the synthetic techniques and on the relations between structure and phase behavior of these new polymers the understanding of the rheological and processing aspects is still far from satisfactory particularly in the case of LCP blends In fact although an appreciable number of patents and scientific papers have appeared describing the phase behavior the rheology and the mechanical properties of many of these polyblends several aspects of the relations between processing and morphology and between morphology and properties of these materials are still obscure or even controversial Now this new book written by leading researchers provides an up to date guide and reference to the processing rheology and applications of pure LCPs and LCP blends The book concisely reviews the synthetic procedures for the production of LCPs and discusses the rheological behavior and processing methods Plus the book examines present and future applications areas of LCPs and LCP blends **Applied**

**Liquid Crystal Polymers**, 1989 **High Performance Polymers and Their Nanocomposites** Visakh P. M., Semkin A.

O., 2018-12-04 High Performance Polymers and Their Nanocomposites fasst die unzhligten Forschungsergebnisse aus der jngsten Zeit im Bereich der Hochleistungspolymere zusammen u a Nanokomposite auf Basis von Hochleistungspolymeren Flssigkristallpolymere Polyamid 4 6 Polyamidimide Polyacrylamide Komposite auf Basis von Polyacrylamiden f r verschiedene Anwendungen Polybenzimidazole Polycyclohexylen Dimethylterephthalate Polyetheretherketone Polyetherimide Polyetherketoneketone Polyetherfulfone Polyphenylensulfide Polyphenylsulfone Polyphthalamide Polysulfone eigenverstrkte Polyphenylene thermoplastische Polyimide **Properties of Polymers** D.W. van Krevelen, Klaas te Nijenhuis, 2009-02-09

This authoritative widely cited book has been used all over the world Properties of Polymers Fourth Edition incorporates the latest developments in the field while maintaining the core objectives of previous editions to correlate properties with chemical structure and to describe methods that permit the estimation and prediction of numerical properties from chemical structure i e nearly all properties of the solid liquid and dissolved states of polymers Extends coverage of critical topics such as electrical and magnetic properties rheological properties of polymer melts and environmental behavior and failure Discusses liquid crystalline polymers across chapters 6 15 and 16 for greater breadth and depth of coverage Increases the number of supporting illustrations from approximately 250 in the previous edition to more than 400 to further aid in visual understanding Multiphase Polymer Systems Andreea Irina Barzic, Silvia Ioan, 2016-09-19

Phase morphology in multicomponent polymer based systems represents the main physical characteristic that allows for control of the material design and implicitly the development of new plastics Emphasizing properties of these promising new materials in both solution and solid phase this book describes the preparation processing properties and practical implications of advanced multiphase systems from macro to nanoscales It covers a wide range of systems including copolymers polymer blends polymer composites gels interpenetrating polymers and layered polymer metal structures describing aspects of polymer science engineering and technology The book analyzes experimental and theoretical aspects regarding the thermal and

electrical transport phenomena and magnetic properties of crucial importance in advanced technologies It reviews the most recent advances concerning morphological rheological interfacial physical fire resistant thermophysical and biomedical properties of multiphase polymer systems Concomitantly the book deals with basic investigation techniques that are sensitive in elucidating the features of each phase It also discusses the latest research trends that offer new solutions for advanced bio and nanotechnologies Introduces an overview of recent studies in the area of multiphase polymer systems their micro and nanostructural evolutions in advanced technologies and provides future outlooks new challenges and opportunities Discusses multicomponent structures that offer enhanced physical mechanical thermal electrical magnetic and optical properties adapted to current requirements of modern technologies Covers a wide range of materials such as composites blends alloys gels and interpenetrating polymer networks Presents new strategies for controlling the micro and nanomorphology and the mechanical properties of multiphase polymeric materials Describes different applications of multiphase polymeric materials in various fields including automotive aeronautics and space industry displays and medicine *Handbook of Thermoplastics* Olagoke Olabisi, Kolapo Adewale, 1997-03-19 Offers coverage of all known commodity transitional engineering high temperature and high performance thermoplastics and analyzes emerging developments in the creation of new thermoplastics The text examines important issues in the field for each substance discussed including history development and commercialization polymer formation mechanisms and process technologies the affect of structural and phase characteristics on properties the commercial relevance of thermoplastic blends alloys copolymers and composites and more

**High Performance Polymers** Johannes Karl Fink, 2014-07-04 Approaching the material from a chemistry and engineering perspective High Performance Polymers presents the most reliable and current data available about state of the art polymerization fabrication and application methods of high performance industrial polymers Chapters are arranged according to the chemical constitution of the individual classes beginning with main chain carbon carbon polymers and leading to ether containing sulfur containing and so on Each chapter follows an easily readable template provides a brief overview and history of the polymer and continues on to such sub topics as monomers polymerization and fabrication properties fabrication methods special additives applications suppliers and commercial grades safety and environmental impact and recycling High Performance Polymers brings a wealth of up to date high performance polymer data to you library in a format that allows for either a fast fact check or more detailed study In this new edition the data has been fully updated to reflect all developments since 2008 particularly in the topics of monomers synthesis of polymers special polymer types and fields of application Presents the state of the art polymerization fabrication and application methods of high performance industrial polymers Provides fundamental information for practicing engineers working in industries that develop advanced applications including electronics automotive and medical Discusses environmental impact and recycling of polymers

Polymer Rheology and Processing A.A. Collyer, L.A. Utracki, 1990-10-31      **Liquid Crystalline Polymers** C.

Carfagna, 2013-10-22 The International Workshop on Liquid Crystalline Polymers LCPs held in June 1993 in Italy attracted many of the leading researchers in this area of polymer science. The meeting provided a forum for the exchange of research and ideas on current developments and future research and applications of liquid crystalline polymers. This volume consists of a selection of the best papers presented at the meeting covering synthesis and characterization, liquid crystalline thermosets, rheology, blends and composites containing LCPs, and transport properties.



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