

Chirality in Liquid Crystals

*Heinz-Siegfried Kitzerow
Christian Bahr,
Editors*

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Chirality In Liquid Crystals

V. A. Belyakov, V. E. Dmitrienko



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Chirality in Liquid Crystals Heinz Kitzerow, Christian Bahr, 2013-03-26 Describes the main aspects of chirality in liquid crystals and points out some of the open questions of current research The chapters review the highlights of the important topics and questions

Introduction to Liquid Crystals Peter J. Collings, Michael Hird, 1997-03-19 This text relies on only introductory level physics and chemistry as the foundation for understanding liquid crystal science Liquid crystals combine the material properties of solids with the flow properties of fluids As such they have provided the foundation for a revolution in low power flat panel display technology LCDs In this book the essential elements of liquid crystal science are introduced and explained from the perspectives of both the chemist and the physicist The text begins with an historical account of the discovery of liquid crystals and continues with a description of how different phases are generated and how different molecular architectures affect liquid crystalline properties The rest of the book is concerned with understanding and explaining the properties of the various types of liquid crystals and in the final part of the book the technology of LCDs is discussed and illustrated

Chirality Effects in Thermotropic and Lyotropic Nematic Liquid Crystals Under Confined Geometries Clarissa Dietrich, 2019-12-09 Chirality is a phenomenon in nature that appears across all disciplines of natural science from biology to mathematics The spontaneous formation of chiral structures in a system of achiral components is known as spontaneous mirror symmetry breaking and is by itself of fundamental interest leading also towards the question of the origin of homochirality in nature in general In this work we show that by means of the topology imposed by the confining geometry and by interfacial boundary conditions in combination with the physical properties of a liquid crystal spontaneous mirror symmetry broken structures can be obtained They are analyzed inter alia with respect to the types of geometrical confinements used e g how the confinement amplifies induces and influences the detection of chirality effects in order to facilitate the measurement of tiny amounts of chiral additives qualitatively and quantitatively

Chirality in Liquid Crystals Heinz Kitzerow, Christian Bahr, 2006-04-28 Objects that differ from their mirror images such as the left and right hands play an important role in physics at all lengths scales from elementary particles to macroscopic systems The handedness or chirality of molecules in liquid crystals has a remarkable influence on the macroscopic physical properties of these systems including the appearance of new phases Indeed the majority of optical applications of liquid crystals is due to chiral structures namely the thermochromic effect of cholesteric liquid crystals the optical activity in twisted nematic liquid crystal displays and the ferroelectric and antiferroelectric switching of smectic liquid crystals This book describes the main aspects of chirality in liquid crystals and points out some of the open questions of current research The chapters each by an expert in the field review the highlights of the important topics and representative

questions in the field of chiral liquid crystals *Chirality in Liquid Crystals - from Bent-cores to Chromonics* Leah Elaine Bergquist, 2017 Chirality is a central scientific concept but its superstructural and nanoscale manifestation are not well understood severely limiting the potential of materials in a range of emerging applications In the first part of this dissertation we examine a lyotropic chromonic liquid crystal LCLC forming a nematic phase for its more intense response to gold nanoparticles capped with chiral L cysteine ligand molecules than to their free molecular counterparts We show that such nanoparticles induce a tighter chiral twist within and similar among the stacks of nematic LCLCs but with several orders of magnitude fewer chiral molecules The second part of this dissertation focuses on the SmCP phase and the development of an optically isotropic antiferroelectric liquid crystal OI AFLC display mode This report describes in detail the synthesis and characterization of a series bent core liquid crystal LC systems Multi component mixtures of these compounds achieved room temperature switching between optically isotropic and birefringent states several mixtures displayed a modulated SmCaPA phase extending from below 40 C up to about 100 C Requiring high fields and showing slow switching speeds their utility is found in non video rate switching applications requiring high contrast **Conformation and Chirality in Liquid Crystals** Lei Zhao, 2018 High helical twisting power additives are required for an expanding variety of liquid crystals and devices Molecular conformation plays a critical role in determining the helical twisting power HTP of chiral additives This dissertation studied additives based on an isosorbide benzoate ester core Molecular modeling molecular spectroscopy is used to explain the different temperature behaviors of HTP and how the chiral additives and liquid crystal hosts interact with each other **Introduction to Liquid Crystals** Peter J. Collings, John W. Goodby, 2019-10-23 Introduction to Liquid Crystals Chemistry and Physics Second Edition relies on only introductory level chemistry and physics as the foundation for understanding liquid crystal science Liquid crystals combine the material properties of solids with the flow properties of fluids As such they have provided the foundation for a revolution in low power flat panel display technology LCDs In this book the essential elements of liquid crystal science are introduced and explained from the perspectives of both the chemist and physicist This new edition relies on only introductory level physics and chemistry as the foundation for understanding liquid crystal science and is therefore ideal for students and recent graduates Features Introduces and explains the essential elements of liquid crystal science including discussion of how liquid crystals have been utilized for innovative and important applications New to this edition are over 300 figures 90 end of chapter exercises and an increased scope that includes recent developments Combines the knowledge of two eminent scientists in the field they have fully updated and expanded the text to cover undergraduate graduate course work as well as current research in what is now a billion dollar industry Immerses the reader in the vocabulary structures data and kinetic models rapidly building up an understanding of the theories and models in current use Begins with a historical account of the discovery of liquid crystals and continues with a description of how different phases are generated and how different molecular architectures affect liquid crystal properties *Chirality in*

Liquid Crystals Leonardo Chiezzi, 2002 *Surfaces and Chirality in Liquid Crystals* Daeseung Kang, 1999 *Optics of Chiral Liquid Crystals* V. A. Belyakov, V. E. Dmitrienko, 1989-01-01 The authors examine the optics of cholesteric and smectic liquid crystals and blue phases in detail Special attention is directed to the properties of liquid crystals near the phase transition temperatures Book club price 46 Annotation copyrighted by Book News Inc Portland OR *Textures of Liquid Crystals* Ingo Dierking, 2003 Table of contents *Chirality in Industry II* A. N. Collins, Gary Sheldrake, J. Crosby, 1998-02-04 This second volume of Chirality in Industry contains new case histories from a wide range of contributors from industry or with strong industrial connections While it is intended that the new volume will stand on its own Volumes I and II taken together present an up to date and comprehensive picture of the technologies required to produce optically active compounds on a multi kilogramme to high tonnage scale as well as illustrating the breadth of application of these technologies the pharmaceuticals agrochemicals electronics food flavour and fragrance industries are all represented Chirality in Industry II All new case histories Unique industrial perspective on chiral technology Emphasis on scale up and process development Comparison of biocatalysis asymmetric synthesis and classical resolution approaches The chiral infrastructure is now largely in place and there is no reason why large scale production should not be possible for even moderately priced single enantiomer products The successful industrial application of chiral chemistry depends on the integration of a range of supporting technologies and there are many examples in this volume of how widely the industrial practitioner must cast the net to achieve practical production methods As with Volume I this new volume is of particular interest to those professionally involved in the scale up processes for single enantiomers However students and researchers involved in a more academic pursuit of optical activity will also benefit from some of the facets of large scale thinking An economic solution is still most likely to be a simple elegant solution *Liquid Crystal Sensors* Albert Schenning, Gregory P. Crawford, Dirk J. Broer, 2017-09-01 Liquid Crystal Sensors discusses novel applications of liquid crystals that lie beyond electrically driven optical switches and displays The main focus is on recent progress in the area of sensors based on low molar mass and polymer liquid crystals This area of research became hot in recent years since the possibilities for applications of liquid crystal sensors are growing in many areas ranging from the detection of mechanical displacements to the detection of environmental pollutants and chemical agents This book is well suited for students as well as scientists from different backgrounds For students and researchers new to the field it gives a thorough introduction For experienced researchers it shows the latest breakthroughs and serves as an inspiration for solving problems or sparking new ideas Key Features Emphasizes how liquid crystals are extremely sensitive to external stimuli and therefore can be used for the construction of stimuli responsive devices such as sensors Includes the contributions of editors who are deeply involved in the field and author chapters on hot topics such as the sensitivity of liquid crystals to pollutants UV light and strain Provides an exclusive on LC sensors where having the data in one place will be very useful to the community Gives more information on sensors and broadens the scope by having a contributed volume rather

than authored Combines recent data on advances in the area of liquid crystal sensors that includes many types of liquid crystal materials

Chiral Liquid Crystals Bengt Otterholm, 1987 Handbook of Liquid Crystals, 8 Volume Set John W. Goodby, Peter J. Collings, Takashi Kato, Carsten Tschierske, Helen Gleeson, Peter Raynes, Volkmar Vill, 2014-04-14 Much more than a slight revision this second edition of the successful Handbook of Liquid Crystals is completely restructured and streamlined with updated as well as completely new topics 100% more content and a new team of editors and authors As such it fills the gap for a definitive single source reference for all those working in the field of organized fluids and will set the standard for the next decade The Handbook's new structure facilitates navigation and combines the presentation of the content by topic and by liquid crystal type A fundamentals volume sets the stage for an understanding of the liquid crystal state of matter while individual volumes cover the main types and forms with a final volume bringing together the diverse liquid crystal phases through their applications This unrivaled all embracing coverage represents the undiluted knowledge on liquid crystals making the Handbook a must have wherever liquid crystals are investigated produced or used and in institutions where their science and technology is taught Also available electronically on Wiley Online Library www.wileyonlinelibrary.com/ref/holc Volume 1 Fundamentals of Liquid Crystals Volume 2 Physical Properties and Phase Behavior of Liquid Crystals Volume 3 Nematic and Chiral Nematic Liquid Crystals Volume 4 Smectic and Columnar Liquid Crystals Volume 5 Non Conventional Liquid Crystals Volume 6 Nanostructured and Amphiphilic Liquid Crystals Volume 7 Supermolecular and Polymeric Liquid Crystals Volume 8 Applications of Liquid Crystals

From a Chiral Molecule to Blue Phases Emine Kemiklioglu, 2018 Chiral molecules play an important role in a wide range from biological structures of plants and animals to chemical systems and liquid crystal display technologies These molecules were used in different research fields due to their opaqueness and iridescent colours changes as a function of the variation in temperature after their discovery by Lehman in 1889 The iridescent colours and different optical textures of cholesterol make it attractive for the new study field of cholesteric liquid crystals The direction of the cholesteric liquid crystals generates a periodic helical structure depending on the chirality of molecules This helical structure might be right or left handed configuration and it is very sensitive to the external conditions such as chiral dopant concentration and temperature The variation in a helical structure which was induced by these external conditions had a great attraction for the scientists working on the chirality in liquid crystals and their applications This chapter will provide a general introduction not only about the chirality in nature and its application in liquid crystals especially in blue phases but also about the trends in the stabilization of blue phases and the investigation of their electro optical properties for advanced applications in display photonic devices

Chirality and Its Spontaneous Symmetry Breaking in Two Liquid Crystal Systems Louis Kang, 2015 Chirality or handedness is a key concept spanning all fields of natural science from biology to mathematics Chiral structures can arise from achiral building blocks that lack a handedness if their assembly is unstable to chiral deformations a phenomenon called spontaneous symmetry

breaking We theoretically study the role of chirality in two systems composed of liquid crystals dissolved or suspended in water and our results match those obtained experimentally by our collaborators In the first system we study achiral liquid crystals whose Frank twist modulus is much lower than their splay and bend Frank moduli and which are confined in capillaries Under homeotropic anchoring their ground state configuration undergoes spontaneous chiral symmetry breaking when the twist modulus decreases enough relative to the splay and bend moduli Under degenerate planar anchoring a small twist to saddle splay ratio of elastic moduli leads to degenerate twisted configurations even though an undeformed configuration is possible Measuring the twist profile of an experimental system produces a value for the saddle splay constant which has been difficult to achieve previously Under either boundary condition domain walls and point defects whose topological charges depend on chirality separate domains with different degenerate configurations and certain ones are energetically preferred over others In the second system we study filamentous viruses acting as colloidal liquid crystals under the influence of depletion which promotes condensation of the viruses into 2D colloidal monolayers These membranes have tunable chirality and show a rich array of emergent behaviors including a transition from a circular shape to a striking starfish shape upon changing the chirality of constituent viruses partial coalescence via domain walls through which the viruses twist by 180 degrees and phase separated rafts of a particular size when two virus species with different lengths and opposite chiralities are used We formulate a simple theory combining Frank elasticity and depletion that shows how entropy and chirality drive the formation and behavior of these diverse structures Our work may facilitate the design of chiral sensors and reconfigurable materials and suggests that chirality contributes not only biochemically but also physically to the behavior of lipid rafts in biomembranes Advances in Cholesteric Liquid Crystals Michel Mitov, 2020-02-05 With their helical structure cholesteric liquid crystals figure prominently in liquid crystal science The selective reflection of light is their flagship property and they offer a myriad of applications as advanced optical materials with multiscale properties The cholesteric structure is also a ubiquitous design in the animal and plant kingdoms This book contains eight contributions on fundamental investigations about defects textures and structures of cholesteric materials and experimental studies aimed at applications such as temperature sensors head up displays for improving automobile driving safety or smart windows

Liquid Crystals Ian R Nemeitz, 2017 This dissertation focuses on liquid crystals LCs specifically their chiral properties and interactions with surfaces and nanostructures Nematic twist cells were filled with a LC doped with the chiral molecule CB15 which compensates for the imposed twist Using the electroclinic effect ECE results indicate that an ECE always exists near the surface in twist cells containing conformationally deracemizable molecules ECE measurements were also performed to determine the source of the ECE response in a LC doped with chiral periodic mesoporous organosilica PMO The data show that the main source of the signal emanates from outside the PMO and not inside the PMO pores An ECE also is reported for chiral LCs above their bulk chiral isotropic nematic phase transition and is observable in the paranematic layers induced by

the planar aligning substrates Optical microscopy measurements were performed on smectic A oily streaks doped with CB15 When chirally doped the stripe orientation rotated by a temperature dependent angle This angle increased with concentration was largest just below the nematic smectic A transition and stabilized to near zero within 1°C below T_{NA} This is explained as a manifestation of a surface ECE Finally a novel structure in a hybrid aligned system was observed below the smectic A smectic C transition The structure appeared as periodic dark and light streaks running perpendicular to the oily streaks and formed by extending discretely from one oily streak to the next eliminating optical evidence of the oily streaks At lower temperatures the streaks undulated in a 2D chiral pattern A possible origin of these streaks is presented

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