

The Fascinating World of Liquid Crystalline And Mesomorphic Polymers Partially Ordered Systems

Liquid crystalline and mesomorphic polymers are unique materials that possess properties of both liquids and solids. They exhibit long-range spatial ordering and have the ability to flow like liquids. This peculiar behavior makes them vital in various applications ranging from optoelectronics to display technologies. In this article, we will explore the mesmerizing characteristics and applications of liquid crystalline and mesomorphic polymers partially ordered systems.

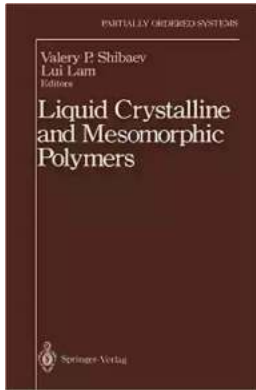
Distinctive Properties

Liquid crystalline polymers (LCPs) are known for their anisotropic properties. Anisotropy refers to the direction-dependent properties of a material. In LCPs, the molecular alignment leads to properties such as birefringence, wherein light passing through the material splits into two rays with different velocities. This property enables them to be used as polarizers in liquid crystal displays (LCDs).

Understanding the Structure

The structure of liquid crystalline and mesomorphic polymers can be visualized as an assembly of rigid rod-like or disk-like segments that are sparsely connected, allowing for partial mobility. This partial mobility accounts for their liquid-like behavior. The ordering and arrangement of these segments give rise to different mesophases, which are distinct organizations of their molecular structure.

**Liquid Crystalline and Mesomorphic Polymers
(Partially Ordered Systems)**



by Lui Lam(1994th Edition, Kindle Edition)

★★★★☆ 4.3 out of 5

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The mesomorphism of liquid crystalline and mesomorphic polymers can be categorized into several types, including nematic, smectic, and cholesteric phases. In the nematic phase, the molecules align parallel to each other but have no positional order. The smectic phase involves layers of molecules with positional and alignment order. Lastly, the cholesteric phase exhibits helical structures, and light interference causes it to display vivid colors.

Applications

Due to their unique properties and structures, liquid crystalline and mesomorphic polymers find applications in various fields:

1. Liquid Crystal Displays (LCDs)

The most well-known application of liquid crystalline polymers is in the production of thin film transistor liquid crystal displays (TFT-LCDs). LCPs act as alignment layers and polarizers, allowing for precise control of the liquid crystal molecules and enabling the display of images.

2. Optical Devices

LCPs have been extensively used in optical devices such as lenses and wave plates. The anisotropic nature of LCPs allows them to manipulate the polarization state of light, making them ideal for controlling and modifying light pathways in various optical systems.

3. Drug Delivery Systems

The ability of liquid crystalline and mesomorphic polymers to form ordered structures can be exploited in drug delivery systems. By incorporating drug molecules into the polymer matrix, controlled release can be achieved, enhancing therapeutic efficacy and reducing side effects.

4. Sensors and Actuators

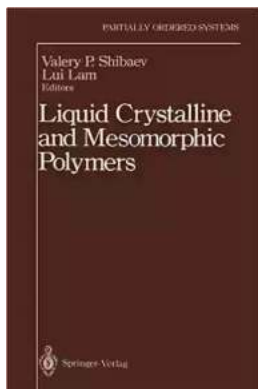
Liquid crystalline polymers have shown great promise in the field of sensors and actuators. Their responsiveness to external stimuli, such as temperature or electric fields, allows them to be used as sensors for detecting changes in environmental conditions. Additionally, their shape memory properties make them suitable for actuators that convert energy into mechanical motion.

Liquid crystalline and mesomorphic polymers partially ordered systems possess unique properties that make them fascinating materials for various applications. Their anisotropy, mesophase formation, and combination of liquid and solid-like properties have opened up new opportunities in fields such as display technologies, optics, drug delivery, and sensors. As research in this area continues, we can expect further advancements and exciting discoveries that will revolutionize many industries.

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Among the various new directions in modern polymer science, the design and investigation of liquid crystal (LC) polymers have been the ones growing most actively and fruitfully. In spite of that, the possible formation of an anisotropic LC phase was only demonstrated theoretically for the first time in the 1950s by Onsager [1] and Flory [2], and then experimentally verified in the studies with polypeptides solutions. In essence, the studies of these LC lyotropic systems did not deviate from the theme of purely academic interest. It was at the beginning of the 1970s that the experimental "explosion" occurred, when aromatic polyamides were synthesized and their ability to form LC solutions in certain very aggressive solvents was discovered. The search for practical applications of such LC systems was crowned with the successful creation of the new generation of ultrastrong high-modulus thermally stable fibers, such as the Kevlar, due to the high degree of order of the macromolecules in the anisotropic LC state. In fact, these investigations coincided with the swift emergence on the practical "scene" of thermotropic low-molar-mass liquid crystals, with the use of these materials in microelectronics and electro optics (figures and letters indicators, displays in personal computers, and flat TV, etc.). Polymer scientists also began to develop methods of synthesizing thermotropic LC polymers by incorporating mesogenic

fragments in the main (main-chain LC polymers) or side branchings of the macromolecules (side-chain or comb shaped polymers).



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