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Opinion

Liquid Crystal Polymers: Novel Applications

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Opinion

Liquid crystals are extraordinary materials, and they are being utilized in every walk of life ranging from mobile phone screens to large screen televisions to smart windows. In this article, we briefly describe some of the novel applications of liquid crystal polymers. Liquid Crystals (LCs) were first discovered by Austrian Botanist F. Reinitzer in 1888 when he perceived the peculiar thermal behaviour of cholesteryl benzoate esters [1,2]. Since then they find many applications in displays, adaptive optical interconnects, optical switches, optical image processors, electro tunable lenses, spatial light modulators, lasers etc. [3]. Liquid crystalline state is a distinct state of matter observed between perfectly disordered isotropic liquid and a completely ordered crystalline solid state. LC molecules have shape anisotropy, and they have ability to self-align themselves. Due to this property LCs show a variety of mesophases each with their explicit behaviour. In addition to this, the organization of the molecules within the mesophase such as nematic, smectic, or other LC types-adds to the numerous of liquid crystal systems and functionalities. These functionalities can be exaggerated by either change in temperature for thermotropic LCs or change in concentration of solute in solvents for lyotropic LCs, while there are certain LCs whose properties can be affected by both means. This ability to affect the creation or dissolution of the liquid crystal provides a method to study as well as manipulate them for beneficial purposes [1]. Extensive research in the field of liquid crystal chemistry led scientists to realize that LC molecules have certain common features; mostly they are antisymmetric although there are examples of symmetric LC molecules, have an aromatic ring, a hydrophobic part, and a hydrophilic portion. This understanding lead to a production of molecules described with a liquid crystal phase which had not previously been identified as such. Discovery of several new mesogenic encouraged researchers to synthesize LC molecules with specific properties. In light of the unique properties postured by LCs, interest ascended in creating more complex molecules which could be of benefit due to their liquid crystal nature (Figure 1). Citing their specific mesogenic features, polymers of liquid crystals were produced which also exhibited distinct properties apart from other polymers. LCPs have been adapted to a wide range of applications. From food containers to mechanical parts to monofilament fibres, liquid crystal polymers have proven to be highly versatile-both in molecular design and properties. In this article, we describe several applications of liquid crystal polymers.

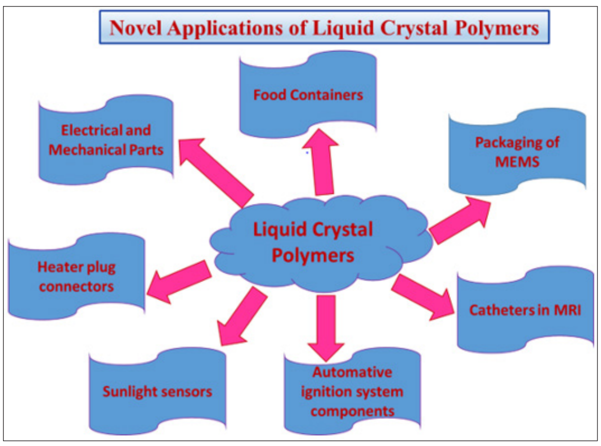

Figure 1: Novel applications of liquid crystal polymers.

These polymeric molecules demonstrate various arrangements which extricate their behaviour from other polymers. As a Liquid Crystal Polymer (LCP), these polymers can be best labelled as a sub-category of thermoplastics. The characteristic double melting behaviour of these provide a processing window suitable for manufacture. With the addition of certain additives, complexity in the production process of these polymers can be eased and these additives can also impart other specific properties to these polymers. Zeus Industrial Products, Inc. have recently synthesized LCP monofilament fibre from p-HBA and HNA. They have overcome a long battle of synthesis of a monofilament fibre with extraordinary mechanical properties. Cylindrical molecules of LC polymers exhibit a nematic mesophase that have ability of self-alignment and orienting themselves orthogonally towards the extrusion. In their mesophase, these LCP have high chain continuity and crystallinity which results into a fibre with outstanding strength and toughness. These LCP monofilament fibres can be used for the production of catheters which are fully compatible with MRI. Due to the chemical inertness and high strength, LCPs are valuable for electrical [4] and mechanical parts, food containers, and various other applications. Low value of relative dielectric constant and dissipation factor leads LCPs good materials for microwave frequency electronics and laminates. LCPs are used as packaging materials for Micro Electromechanical Systems (MEMS). The superior properties of LCPs are also utilized in making automotive ignition system components, heater plug connectors, lamp sockets, transmission system components, pump components, coil forms and sunlight sensors and sensors for car safety belts. They are suitable materials for computer fans due to their large tensile strength and rigidity.

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