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Editorial

Nematic Liquid Crystals

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Citation: Jasiurkowska-Delaporte, M.; Kolek, Ł. Nematic Liquid Crystals. *Crystals* **2021**, *11*, 381. https://doi.org/10.3390/cryst11040381

Received: 29 March 2021
Accepted: 3 April 2021
Published: 6 April 2021

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The discovery of liquid crystals (LCs) is dated to the year 1888, when Friedrich Reinitzer reported his observation of the double melting points of cholesterol benzoate. The LC state is an intermediate state between the three dimensionally ordered crystal and the isotropic liquid. LCs are characterized by the combination of partial ordering, leading to anisotropic physical properties; and fluidity, which allows control of molecular alignment by external stimuli, such as magnetic and electric fields. This unique combination of properties makes them attractive for various applications. Despite LCs being usually associated with display technology, they also have a multitude of other applications, including tunable filtering, tunable lenses, organic photovoltaics, biosensors, terahertz and microwave photonics, among others. The nematic (N) is the simplest liquid crystalline phase exhibiting the long range orientational order of anisotropic shape molecules (often rod-like or disc-like molecules). Its chiral version, N* (cholesteric phase), is composed of chiral molecules forming a helical superstructure. Other types of nematic phases are the blue phase, biaxial nematic phase (N_B), and twist-bend nematic phase (NTB). This Special Issue presents various aspects of current research on nematic phases.

The collection begins with the paper by Barnes et al. [1] devoted to paclitaxel-stabilized microtubule (PTX-MT) solutions. The authors examined the mechanisms leading to the formation of birefringent domains showing local nematic liquid crystalline order. The impact of thermal anisotropy, incubation time, and PTX concentration on organization of MTs were discussed. The paper by Drozd-Rzoska [2] aimed for a better understanding of the nature of isotropic to nematic phase transition and the vitrification process of nematic phase. This is studied was based on broadband dielectric spectroscopy results and nonlinear dielectric effect for well- known pentylcyanobiphenyl (5CB). The dielectric data were analyzed in terms of dynamics properties and the "quasi-critical" approach. Cirtoaje et al. [3] report theoretical considerations of the Freedericksz transition in two ferronematics based on 5CB and CCN-37 liquid crystals. The elastic continuum theory and Gouchen model were employed to demonstrate the significant influence of the anchoring forces and laser beam on the critical field and saturation field in ferronematics. The issue also contains papers on liquid crystal gratings. Nieborek et al. [4] present preparation and characterization of diffraction gratings composed of nematic liquid crystals and azo polymer-coated substrates. The impact of gold nanoparticle dopants in nematic mixtures on spectroscopic and electro-optical properties of the devices were also reported. While the contribution by Stebryte et al. [5] describes the fabrication of gratings based on chiral liquid crystal (CLC) with a photonic bandgap in the visible range. Analysis of experimental and numerically simulated transmission spectra of CLC gratings revealed their high diffraction efficiencies and operation under large angles of incidence. Son and Lee [6] proposed an alignment method for nematic LCs using a silver nanowire coated substrate and 4-(4-heptylphenyl)benzoic acids, and contrasted it with the conventional cell composed with indium tin oxide substrate and polyimide alignment layer. Osipov et al. [7] present approximate analytical expressions for the dielectric susceptibility of nematic nanocomposites. The expressions developed by the authors were used to describe the split and the shift of the plasmon resonance in nematic nanocomposites containing gold and silver nanoparticles. Bury et al. investigated the influence of magnetic nanoparticles of Fe_3O_4 with nanorod shape on structural changes in the nematic phase using the surface acoustic waves method. The authors discussed the impact of nanoparticle concentration on the phase transition temperatures of 6CHBT liquid crystal [8]. The contribution by Aouini et al. [9] presents the complete phase diagram of the binary mixture of twist-bend nematic liquid crystal (CB7CB) and the smectogen (8CB). It also reports a detailed characterization of studied system, in terms of its optical, dielectric, thermal, and elastic properties. Lee et al. [10] describe the impact of chirality of liquid crystal monomers and concentration of ions trapped within the polymer network on the electro-optic (EO) response of polymer-stabilized cholesteric liquid crystals (PSCLCs). Finally, the papers characterize nematic phase behavior at millimeter wave, and report microwave frequencies applications. Nova et al. [11] focused on developing a method which allow determination of the dielectric permittivity and loss tangent in the nematic phase at microwave frequencies under different polarization voltages, as well as splay elastic constant and rotational viscosity by means of a single device. Tesmer et al. [12] report the temperature dependent characterization of the LC phase shifter at millimeter wave frequencies.

Acknowledgments: We would like to thank all the authors for their contributions to this special issue. We also expect that the special issue will stimulate fruitful discussion within the liquid crystal community.

Conflicts of Interest: The authors declare no conflict of interest.

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