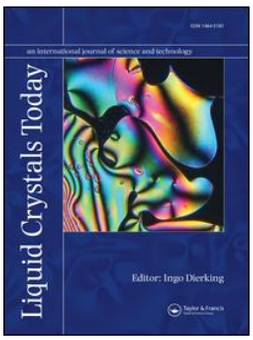

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Research news

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NEWS

Research news

Emergence of radial tree of bend stipes in active nematics by A. Sokolov et al., Phys. Rev. X, 9, 031014 (2019)

Pattern formation in out-of-equilibrium systems is diverse. Examining the nature of hydrodynamic patterns in active nematics has been a topic of interest for the past couple of years. Sokolov et al. investigate the dynamics of circularly aligned swimming bacteria. They show that in an active matter system the interplay of activity, elasticity and geometry leads to a well-controlled pattern formation and finer control of dynamic structures and transport phenomena. They report the emergence of bend stripes, an activity-induced undulations of the liquid crystal director field, in areas of high local curvature. Parameters such as velocity, relaxation rate and vorticity are compared for two experimental geometries; a pendant drop attached to a glass slide and in a thin free-standing film suspended between filaments. Hydrodynamic simulations are used to explain the origin of bend stripes. The effect of adding an extensile active stress on the hydrodynamic flows and its implications on the time evolution of the director field and the local curvature are compared. The instability patterns are seen to introduce a strong anisotropy to the angular distribution of emerging topological defects.

Electrically controlled liquid crystal elastomer-based soft tubular actuator with multimodal actuation by Q. He et al., Sci. Adv. 5, eaax5746 (2019)

Soft actuators that can be controlled by external stimuli are useful for several applications. Actuators made from stimuli responsive materials such as liquid crystals will potentially simplify fabrication and assembly processes. Also, liquid crystals provide reversible actuation and compared to liquid crystal actuators, dielectric elastomer actuators have been shown to give much faster speed and energy efficiency, but the liquid crystal elastomer actuators leverage the stiff frames required to maintain pre-stretch in dielectric systems. He et al. present an untethered soft robot with on-board power source and microcontroller, mainly driven by the liquid crystal tubular actuations. The tubular actuators on their own exhibits multidirectional bending and homogenous contraction under an electrical field. A contraction of 41% of its initial length was observed for 3 V applied across the sample and it takes about 30 s to reach the maximum contraction. Bending angle and contraction of tubes as function of time for different actuating voltages are studied. Further, a soft gripper that can be controlled electrically was built using the tubular actuator. By selectively activating the heating wires in each tubular actuator of the gripper through micro-controller, the gripper is shown to grasp and lift a vial and also twist its cap without additional external control.

Reconfiguration of three-dimensional liquid crystalline photonic crystals by electrostriction by Guo et al., Nat. Mater. doi/10.1038/nature.s41563-019-0512-3

Guo et al. reports the possibility to obtain a non-cubic lattice from a cubic lattice by employing a repetitive applied field. They reconfigure the defect network of blue phase liquid crystals having cubic symmetry into orthorhombic and tetragonal lattice structures. They introduce a time interval between each field application to allow the director axis to relax to a metastable intermediate state. The metastable state is then triggered again to transit to a new reconfigured crystal structure. The resultant final non-cubic blue phase crystals are found to be stable and they are further polymer-stabilised to yield large operating temperature ranges and sub-millisecond electro-optic response. Detailed dynamical responses of BPI and BPII phases to applied electric fields are given in the paper.

Iridescence in nematics: photonic liquid crystals of nanoplates in absence of long-range periodicity by M. Zeng et al., PNAS, doi/10.1073/pnas.1906511116

Developing approaches to understand and manipulate the mesoscopic ordering of colloidal particles

will significantly forward practical application of 2D nanomaterials.

Zeng et al. show that a colloidal nematic dispersion of nanodiscs is able to reflect a broad-spectrum wavelength. The reflection colours are enhanced by adding carbon nanoparticles to the mixture to reduce background scattering. They have used a dispersion based on unexfoliated zirconium hydrogen phosphate, ZrHP, particles. The authors show that the colours can be tuned by particle concentration and the colours are not highly sensitive to surface anchoring. It is hypothesised that the large plate size and low thickness polydispersity might improve interlayer interactions, producing a stable smectic-like layer ordering with a short correlation length in the N phase. Results from scanning electron microscopy are provided to prove the cybotactic nature of the nematic phase. A photonic palette having pigments with red, yellow, green and blue colours was developed by adding the proper amount of water into concentrated ZrHP suspensions. These photonic inks are used to write on a glass substrate.

Three-dimensional crystals of adaptive knots, by Tai et al., science 365, 1449 (2019)

Tai et al. show the formation of 3D crystalline lattices with open and closed configurations, of topological knot solitons in chiral nematic liquid crystals. The knot solitons are embedded in the helical background and form spontaneously after transition from the isotropic to the liquid crystal phase under a weak electric field. The crystal structures are shown to be energetically stable and resemble colloidal particles and atoms self-assembling into crystalline lattices. The crystals are called heliknoton crystals and unlike the atomic, molecular, and colloidal crystals, heliknoton crystals are found to exhibit giant electrostriction and marked symmetry transformations under small voltages. Also, heliknotons undergo Brownian motions and exhibit anisotropic interactions.

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