

Mechanical and Chemical Stimuli-Induced Structural Transitions in Aqueous Phase Interfaced Liquid Crystal Microfluidics

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Soft interfaces formed by intersecting a thermotropic liquid crystals (LCs) and aqueous phases possess significant opportunities to develop biological sensors as they are generally considered as physicochemical equivalents of cell membranes and they can optically amplify minor chemical changes of a wide range of biological species through orientational changes.[1] We investigate the shear and chemical interaction-induced structures and structural transitions in a LC-aqueous two-phase microfluidic system formed by preferential wetting of the two phases on a heterogeneous interface with distinct hydrophilic and hydrophobic functionalization. The interface was stable enough to maintain a co-current and countercurrent flow configuration of the two phases and allow the adsorption of the species of analytical interest that causes alignment transitions in the LC phases. We (i) show how to maintain an intact LC-aqueous interface during pressure-driven flow (up to 40 mbar of the pressure difference between the two phases) that allow co-current and counter-current flow configurations and induction of interfacial shear [2], (ii) quantified the influence of the bulk and interfacial shear on the structures of the nematic LCs that resulted in more than 16 flow-induced configurations [3], (iii) investigate the role of the non-uniform orientation of LCs on their flow characteristics, (iv) demonstrate the configurational changes in LCs that result from molecular interactions with the LC-aqueous interfaces (example shown in Figure 1). Overall, we show that the LC-aqueous soft interfaced platform promises a good candidate for future high-throughput sensing platforms.

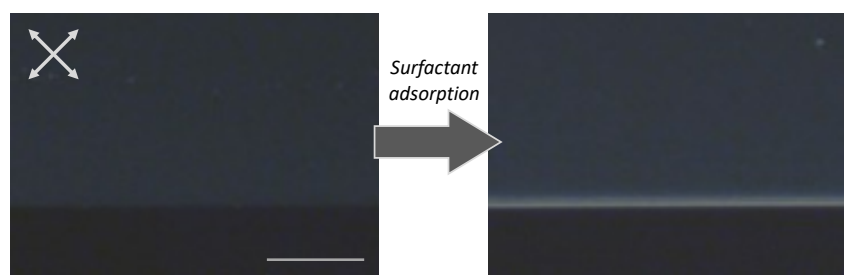


Figure 1. Polarized optical micrographs of aqueous-interfaced nematic LC (5CB) before and after adsorption of 1 mM sodium dodecyl sulfate. The increase in the brightness at the LC-aqueous interface is an indicative of an ordering transition. The double-sided arrows show the directions of the polarizer and the analyzer. Scale bar: 100 μm .

References

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Acknowledgments

Funding was provided by the European Union (ERC-StG-2021, LCFlow, 101039294).