A new pathway of formation of radial nematic droplets within a lipid laden aqueous-liquid crystal interface

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Recently, liquid crystal (LC) droplets are widely appreciated as a new class of functional materials owing to their large surface areas, rich phases, well-defined director configurations and unique tunable optical properties. In particular, they offer routes to the development in designing simple, economic and convenient passive sensing devices that provide high spatial resolution of micrometers with a very high sensitivity. Therefore, it is very important to explore new pathways of preparation of stable and uniform LC droplets that will ultimately provide a simplified and robust LC sensing platform. Past reports establish the feasibility of formation of LC droplets via sequential ultra-sonication and vortexing of LC in water with emulsifying agents. However, droplets prepared using these methods have less stability and broad size distribution that limits their widespread use in real applications. To address these issues, much progress has been made to stabilize the LC droplets with uniform sizes. For example, uniform silica particles coated with polyelectrolyte’s multilayers (PEM), microfluidic devices, etc. have been used as templates for stable and uniform LC droplets. These polyelectrolyte’s and other surface active agents (e.g., surfactants) can assemble at the interface of the LC droplet giving rise to a stable director configuration that is governed by surface anchoring and bulk elastic energies of the LC. But, most of these techniques are either tedious or not suitable for large scale production.

Herein, we report a new pathway for easy formation of spontaneous uniform LC droplets. While the techniques reported for the preparation of LC droplets in past have a life span of few hours, our approach rendered with their stability for days to months. We observed spontaneous formation of well-developed LC droplets with radial defects in presence of phosphatidylcholine (PC) within the confined boundary created by grid system (Fig. 1), suggesting new principles for the design of LC-based chemical and biological sensors.

Fig. 1 A) Crossed polars (CP) and B) bright field (BF) images of aqueous-5CB interfaces within TEM grids supported on DMOAP coated glass slides upon exposure to 0.5 mg/mL phosphatidyl choline (PC) after 10 min, 6 h and 24 h, respectively. The insets (in A & B) show the corresponding high-magnification images that reveal the formation of stable and well-developed LC droplets exhibiting radial configuration. Scale bar = 40 μm.

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