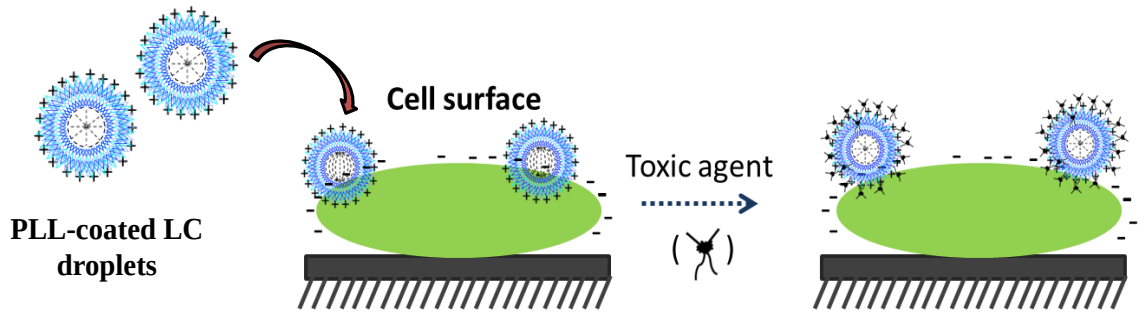
POLY(L‑LYSINE)-COATED LIQUID CRYSTAL DROPLETS FOR SENSING CELLULAR EVENTS

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In this paper, we were interested in preparing LC droplets that could fulfill significant knowledge gap in understanding the intermolecular interactions that underlie the direct ordering of LCs with protein-decorated surfaces and hold great promise to provide LCs as cell surface sensors. The motivation for these studies are based on the prior reports in which the interfacial interactions of LC materials have been made specific to bind antibodies, bacteria, viruses and cells by using specific ligands.[1-8] Here our primary focus is broadly based on potential utility of LCs as responsive materials that can be used as cell surface sensors to monitor the cellular environment based on the configurational transitions of LCs and also the use of LCs to create material environments that can be used to direct cell behaviors. For this, we have exploited the use of Poly-L-lysine (PLL) to prepare LC droplets. The intermolecular interactions between PLL and LC can provide a dynamic LC response in aqueous media which can offer the possibility of expanding these systems to communicate and interact to a diverse range of targets in the cellular environment.and can trigger the configurational transitions of the droplets which can be detected as changes in optical appearance of the LC.
For this, we investigated the orientations of nematic 5CB on PLL laden surface at aqueous/LC interface. Interesting, we found the change in optical appearance of the LC which is indeed consistent with adsorption and pre-organization of PLL at the interface to the aqueous phase of 5CB, thereby allowing a rapid ordering transition. In contrast, low molecular weight PLL solution (3.5 kDa) was unable to show the change in optical appearance of the LC. We have performed Fourier transform PM-IRRAS measurements to characterize the thin films of PLL decorated with 5CB to provide additional insight into intermolecular interactions between PLL and 5CB.



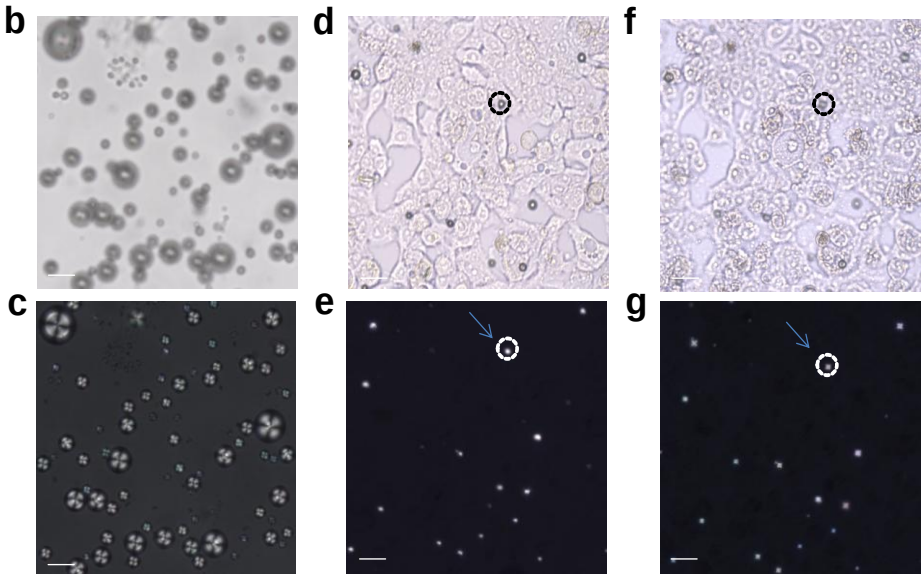


Figure 1. a) Schematic showing PLL-coated LC droplets undergo transition from PLL radial configuration to bipolar configuration after anchored to cells. In addition, PLL-coated LC droplets are in bipolar states until toxic surfactant is added to promote a transition to radial states. Bright-field and crossed polar images of PLL coated LC droplets before (b,c) and after (d,e) contact with cells. The LC droplets were in radial states before but transitioned to bipolar state (d,e) after anchored to cells. (f,g) Bright-field and polarized microscopic images of PLL coated LC droplets anchored on cells after addition of HTAB. The ordering transition of PLL-coated LC droplets attached with cells change from bipolar to radial after adsorption of HTAB through PLL layer and then interact with LC. Scale bar = 40 μm.

Next we designed a simple experimental design of PLL-coated LC droplets for the adherence on the surface of cells. In this endeavor, our approach revolves around the preparation of PLL-coated LC droplets by using layer-by-layer technique. Further, we explore these PLL-coated LC droplets for cell substrate interaction(Figure 1a). The optical micrographs as shown in Figure 1b,c reveal that, PLL-coated LC micro-droplets retain radial configuration and remained stable in contact with culture media (DMEM). Inspection of crossed polarizer and bright field images (Figure 1d,e) reveal that, PLL-coated droplets in contact with cells, respectively. Interestingly, in contact with cells, PLL-coated droplets result a rapid change from the radial state to the so-called bipolar configuration that confirms the cell-adhesive nature of these droplets. In addition, cell-attached bipolar LC droplets changetheir ordering transition to a radial ordering on addition of HTAB(Figure 1f,g). These results reveal that these PLL-coated LC droplets can be exploited for the adherence on the surface of cells and can be used for cell substrate interaction.[9] Studies to exploit these modified PLL-coated LC droplets in cell based studies, poly-ionic drugs based interaction (heparin and protamine)and other applications (Apoptosis and DNA) are currently in progress in our laboratory. In addition to this, we are heading towards studying amyloidogenic peptides at the LC-aqueous interface which offers the potential for early diagnoses of neurodegenerative diseases.

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