Photonic Behavior of Cholesteric Liquid Crystal Emulsions determined by Alkyl Chain Length of Nematic Liquid Crystals

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Cholesteric liquid crystals confined in 3D emulsions are useful in various sensing scenarios in microscale due to their unique optical properties determined by the temperature-responsive helical pitch. In such curved geometries, an interplay between interfacial and elastic contributions to free energy occurs, leading to interesting configurations of LC director fields. In this study, liquid crystal (LC) droplets with multiple photonic stopbands are created by the mixtures of cholesteryl oleyl carbonate (COC) and nematic cyanobiphenyl (CB) with different alkyl chain lengths. The use of poly(vinyl alcohol) provides a planar anchoring condition at the aqueous interface yielding radial disposition of helical axis. The reciprocal pitch exhibits unique function of cyanobiphenyl concentration, suggesting integration of CB monomers and dimers between COC molecules. Moreover, an increase of alkyl chain length of CB from 4 to 8 results in the shift of cholesteric to smectic transition. Finally, dynamic photonic behavior is tested by repeated heating-cooling cycles, suggesting our LC emulsions are soft materials that will find utility in a variety of colorful applications.