Photonic Droplets with Multiple Photonic Bandgaps created by Successive Phase Separations of Cholesteric Liquid Crystals

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Cholesteric liquid crystals (CLCs) construct a helical superstructure which exhibits photonic bandgap due to its periodic spatial modulation of refractive index along the helical axis. Micro-compartments of CLCs facilitate this photonic property for various applications such as sensing, lasing, and optical barcoding. To provide advanced functionality, the integration of distinct CLCs into a single microgranule can be adopted. However, it is challenging to fabricate multishell structure of CLCs without a complicated multiphase flow system. Here, we suggest a simple and autonomous production of CLC multishells through liquid-liquid phase separation (LLPS). The multiplicity of emulsion drops is controlled up to five by adjusting the initial composition of the ternary mixture. The chiral dopant is unevenly partitioned in CLC multilayers in an odd yet expected manner during LLPS. Therefore, the resultant single microgranules contain multiple stopbands in CLC-rich layers developing internal photonic communication. Moreover, stopbands at distinct layers enable band-edge lasing at two different CLC-rich layers or, equivalently, two different wavelengths from the single structures.