259a Lyotropic Chromonic Liquid Crystals: Self-Assembly and Emerging Optical and Biological Applications

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Lyotropic chromonic liquid crystals (LCLCs) are formed by water-soluble molecules with rigid polyaromatic cores and ionic groups at the periphery (usually deprived of aliphatic tails). Face-to-face-stacking of molecules results in aggregates of variable length and geometry that are very different from the closed finite-size micelles in surfactant-based lyotropic LCs. We describe the physical properties and potential applications of LCLCs. Light scattering experiments demonstrate that the isotropic-to-nematic pretransitional behavior does not follow the classic Landau - de Gennes model, as the length of aggregates changes with temperature. Most of the LCLCs are not toxic and can be used as an amplifying medium in biosensors. The detector is based on the principle that the immune aggregates growing in the LCLC bulk and containing the microbes to be detected change the director pattern once they grow above the anchoring extrapolation scale. Self-assembly of LCLC molecules into oriented structures allows one to use them in various structured films. For example, layer-by-layer electrostatic deposition produces monomolecular layers and stacks of layers of LCLC with long-range in-plane orientational order which sets them apart from the standard Langmuir-Blodgett films. Uniformly aligned films of 0.01-1 micron thickness can be used in optical polarizers and compensators. Work supported by NSF DMR-0315523, DMR-0346348, and CRDF UKP1-2617-KV-04.