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Fluorophore Self-Assembly in Liquid Crystals

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Liquid crystals are a state of matter between liquid and solid that is observed in various substances. They are characterized by a clear directional order of the molecule called the nematic phase. We are analyzing the behavior of 4-Cyano-4'-pentylbiphenyl (5CB) molecules in response to various external fields, which are conditions often used in liquid crystal displays (LCDs). While 5CB behavior in electric fields is well understood, its characteristics in magnetic fields are yet to be studied. Past work in the Yodh Lab has investigated droplets of 5CB and how their configuration transforms under a magnetic field. In this project, we are using the fluorophore 4,4-Difluoro-5,7-Dimethyl-4-Bora-3a,4a-Diaza-s-Indacene-3-Pentanoic Acid (BODIPY-C5) to visualize and understand the defect transition of radial 5CB drops in response to magnetic fields. With zero applied magnetic field, radial droplets with 5CB molecules arranged from the center to the outer edges were observed. As the magnetic field was increased, the 5CB molecules rearranged to be increasingly aligned with the direction of the field. Similarly, droplet defects (regions in which 5CB molecules do not have a uniform direction) also changed configuration, starting out as a point defect in the zero applied magnetic field configuration and opening up to a ring defect with an increasing magnetic field. To anticipate how the fluorophores will behave along a defect, we first add them to topological defects that are synthetically formed using the planar rubbing procedure of ITO-coated substrates. Fluorescence microscopy is used to observe and take images of droplets through reflected light, and the fluorescence intensity distribution is quantified using ImageJ software. Preliminary results of the fluorophores in the drops show that at zero magnetic field, the fluorescence intensity is lowest towards the center of the radial droplets containing the point defect. Future work includes using confocal microscopy to analyze the layers of the 3-dimensional droplets and quantify the change in intensity over an increasing magnetic field.

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