Design of Biotic-Abiotic Interfaces using Liquid Crystals

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Many biological molecules form liquid crystalline phases. The unique combination of long-range molecular ordering and mobility found in liquid crystals has been exploited by nature to create a range of functional and living systems. We are pursuing studies that seek to create synthetic liquid crystalline materials that recapitulate biological design principles and can be used to couple biotic and abiotic systems in useful ways. In one approach, we are exploring the self-assembly of biological amphiphiles at the interfaces of synthetic liquid crystals and also within their topological defects. New principles that permit ordering to propagate from the nanoscale to the optical scale will be described. In a second approach, we are using the anisotropic mechanical properties of liquid crystals to design materials than can be used to regulate the organization and function of living bacterial systems. These two lines of investigation, which encompass a broad range of colloidal and interfacial phenomena involving liquid crystals, will be discussed. Fundamental challenges and technological opportunities will be described.