ESTABLISHING FUNDAMENTAL PROCESSING-STRUCTURE-PERFORMANCE RELATIONSHIPS OF MAGIC DOT LIQUID CRYSTALS

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We recently discovered a novel class of nanostructured materials comprised of magic-sized dot arranged into a fibrous network. Although detailed structural analysis is still ongoing, one current hypothesis is that these structures consist of magic dots arranged fibers which in turn arrange into micrometer scale bands. The constituent dots are called 'magic' because they only occur in well-defined specific sizes (analogous to e.g., C60). In light of the fibrous nature of these hierarchical materials, one intriguing question is whether these materials exhibit liquid-crystal properties.

The overarching objective of this project is to explore optical characteristics of this novel material by establishing the fundamental relationship between structure and processing of the magic liquid crystals and their optical properties. Given that these materials are already available, we expect to make rapid progress on the specific research objectives outlined below:

1. fabricate sample films under conditions of controlled evaporation rate and shear. We hypothesize that the degree of fiber alignment can be controlled with via shear (based on previous results with other nanostructured fibers).
2. study optical birefringence of the films using cross-polarized optical microscopy.
3. using feedback between optical properties and processing conditions, refine the formation of magic liquid crystal films with controlled long-range alignment of the fibers.
4. measure circular dichroism (CD). If the hypothesized structure of a tetrahelix fiber is correct, the structures should be optically chiral. CD is a relatively simple optical characterization technique.