Materials Science & Engineering Seminar Series

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presents

Spontaneous Emergence of Chirality in Achiral Systems

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ABSTRACT:
Lyotropic chromonic liquid crystals (LCLCs) are a relatively new class of liquid crystals (LCs) that have attracted considerable attention in recent years. Applications of these materials have been explored as polarizers, optical compensators, biosensors, precursors of aligned graphene and templates for mesoporous nanofibers. LCLCs consist of many dyes, drugs, nucleic acids, antibiotics, carcinogens and anti-cancer agents. In this talk I will explore the spontaneous emergence of chiral structures from achiral lyotropic chromonic liquid crystals when confined to cylindrical capillaries with various boundary conditions. When confined to a cylindrical geometry with planar boundary conditions, the presumed ground state of a nematic fluid corresponds to that of an axial configuration, where the director, free of deformations, lies along the long axis of the cylinder. However, upon confinement of lyotropic chromonic liquid crystals in cylindrical geometries, we uncover a surprising ground state corresponding to a doubly twisted director configuration. The stability of this ground state, which involves significant director deformations, can be rationalized by the saddle-splay contribution to the free energy. It will be shown that sufficient anisotropy in the elastic constants drives the transition from a deformation-free ground state to a doubly twisted structure, and results in spontaneous reflection symmetry breaking with equal propensity for either handedness. Enabled by the twist angle measurements of the spontaneous twist, we determine the saddle-splay elastic constant for chromonic liquid crystals. I will also discuss the path to a monodomain or a single crystal, if you will, of chrominc liquid crystals confined to a rectangular capillary enabled by a spontaneous twist deformation.
Nayani, K. *et al*. Spontaneous emergence of chirality in achiral lyotropic chromonic liquid crystals confined to cylinders. *Nat. Commun.* 6:8067 doi: 10.1038/ncomms9067 (2015).

BIOGRAPHY:
He received his B.Sc. (Applied Sciences) from the University of Madurai in 1979, and M.Sc. (Applied Chemistry) from the University of Madras in 1981. He received his M.S. (Polymer Science) in 1985 and Ph.D. in Chemistry in 1990, both from Carnegie Mellon University. He worked on flow and magnetic field induced instabilities of a rodlike polymer forming a nematic phase in solution under the supervision of Professor Guy Berry. He spent a few years as a postdoctoral fellow with Professor Richard S. Stein at the University of Massachusetts at Amherst before moving to AT&T Bell Labs where he worked on polymer-dispersed liquid crystals for display device applications. He spent four years as an Assistant Professor at North Carolina State University before moving to Georgia Institute of Technology in 1999. Presently he is a full professor at Georgia Institute of Technology and works on a number of different problems related to physical chemistry of polymers, physics of nematic liquid crystals, optics of liquid crystals, rheology/rheo-optics of polymeric fluids and liquid crystals, and nano-optics in the biological world (color of butterfly wings, beetles, moths, and bird feathers). He is also a Fellow of the American Physical Society (APS) and American Association for Advancement of Science (AAAS).

Doherty Hall 2315, 11:30AM
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