Stevens Institute of Technology

Nanotechnology Graduate Program

Morphological Multiplicities in Liquid Crystalline Droplets

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Dispersions of nematic liquid crystalline droplets in a polymeric matrix are of interest in many areas of science and engineering, including device technology. The functional properties of these multiphase systems often depend on the liquid crystalline orientation distribution in the droplet. Multiple locally stable morphological states can exist in liquid crystalline dispersions. We have observed bistability in a dispersion of the biphenylcarbonitrile 8CB in polydimethylsiloxane, for example, where a bicontinuous gel-like morphology and dispersed droplets with a radial conformation can both exist within the nematic temperature regime. The dispersed droplet morphology appears to be the lower energy state for the nematic, but the gel breaks up into a low-viscosity dispersed droplet system only when the temperature is raised above the nematic-isotropic transition. We have speculated that an extended liquid crystalline structure that creates the gel is kinetically trapped because of a large energy barrier between the extended and spherical states. In this talk we first explore the orientational morphologies of spherical and spheroidal droplets of nematic liquid crystals using a simulated annealing approach, with particular attention to bistability; the transitions between locally stable states; and the energy barriers for such transitions. We then extend this approach to liquid crystalline cylinders and to the development of pathways by which a liquid crystalline cylinder might break up into droplets. A morphological transition with a finite energy barrier is required, and it is possible that progress towards breakup will be kinetically trapped in a varicose cylindrical shape without the possibility of breakup. This energy barrier may be related to the kinetic trapping mentioned above.

Morton M. Denn is the Albert Einstein Professor of Science and Director of the Benjamin Levich Institute for Physico-Chemical Hydrodynamics at the City College of New York, CUNY, with faculty appointments in Chemical Engineering and Physics. He was previously Professor of Chemical Engineering at the University of California, Berkeley, where he served as Department Chair; Program Leader for Polymers and Head of Materials Chemistry in the Materials Sciences Division of the Lawrence Berkeley National Laboratory; and the Allan P. Colburn Professor of Chemical Engineering at the University of Delaware. Professor Denn is a member of the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, a Guggenheim Fellow, and the recipient of numerous awards from AIChE, ASEE, and the Society of Rheology. He is the author of six books on subjects ranging from process optimization to fluid mechanics.

Light refreshments will be served prior to seminar

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