Elastic Interactions and Manipulation of Ferromagnetic Nanowires in Patterned Nematic Liquid Crystals

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Anisotropic particles suspended in a nematic liquid crystal disturb the alignment of the liquid crystal molecules and experience small forces and torques mediated by the elasticity of the fluid. These elastic interactions depend upon the orientation of the particle relative to the alignment of the liquid crystal as well as the nature of the anchoring at the particle's surface. An axially symmetric particle with longitudinal surface anchoring (planar and along the long-axis) aligns parallel to the nematic director to minimize elastic deformations of the director field. Rotating the particle away from its equilibrium orientation costs elastic energy resulting in an orientation dependant elastic torque. This torque is converted to a translational elastic force when the director field is non-uniform as has been previously shown through video microscopy experiments on magnetic nanowires suspended in twisted nematic liquid crystal cells[1,2]. In this talk, we discuss the results of a series of demonstrative experiments in which these elastic forces were utilized to manipulate isolated nanowires as well as to drive collections of nanowires to selective locations in patterned nematic liquid crystal cells by orienting them with external magnetic fields.

[1] C. Lapointe, A. Hultgren, D. M. Silevitch, E. J. Felton, D. H. Reich, and R. L. Leheny, Science **303**, 652 (2004).

[2] C. Lapointe, N. Cappallo, D. H. Reich, and R. L. Leheny, J. Appl. Phys. **97**, 10Q304 (2005).