On Singular Limits in Polymer Stabilized Liquid Crystals

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We investigate equilibrium configurations for a polymer stabilized liquid crystal material subject to an applied magnetic field. The configurations are determined by energy minimization where the energies of the system include those of bulk, surface, and external field. The Euler-Lagrange equation is a nonlinear PDE with nonlinear boundary conditions defined on a perforated domain modeling the cross section of the liquid crystal-polymer fiber composite. We analyze the critical values for the external magnetic field representing Fredericks transitions and describe the equilibrium configurations under any magnitude of the external field. We also discuss the limit of the critical values and configurations as the number of polymer fibers approaches infinity. In the case where away from the boundary of the composite, the fibers are part of a periodic array, we prove that non-constant configurations develop order-one oscillations on the scale of the array's period. Further more we determine the small-scale structure of the configurations as the period tends to zero.

Presented by Dan Phillips