A PDE Model for Phase Transitions in Liquid Crystals with Chirality

P. Bauman
Purdue University, USA
e-mail bauman@math.purdue.edu

M.C. Calderer
University of Minnesota, USA
e-mail mcc@math.umn.edu

C. Liu
Penn State University, USA
e-mail liu@math.psu.edu

D. Phillips
Purdue University, USA
e-mail phillips@math.purdue.edu

We study the Landau-de Gennes free energy used to describe the transition between chiral nematic and smectic A liquid crystal phases. We consider the phenomenology of the transition and discuss the behavior of the material constants. Within the present mathematical framework, the physically observed growth behavior of the *twist and bend* Frank constants, K_2 and K_3 respectively, plays a major role in determining the transition regime. We show existence of minimizers in a large class of admissible fields. Then under the hypothesis that K_2 and K_3 are large, we establish estimates for the transition regime separating the two phases. The work emphasizes the interplay between two competing effects: the layer formation of the smectic A phase and the twist tendency of the chiral nematic phase. Our discussion also illustrates the analogies as well as the discrepancies in modeling and behavior between smectic A* liquid crystals and superconducting materials described by the Ginzburg-Landau theory.

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