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THE SINGULAR-PERTURBATION ASYMPTOTICS AND NUMERICS OF FLOW IN SMECTIC A LIQUID CRYSTALS

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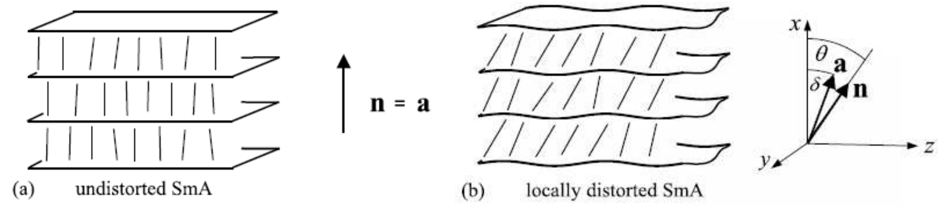

Figure 1. (a) A schematic diagram of locally arranged planar layers of SmA liquid crystal. In an undistorted configuration in the bulk, away from any boundary influences, the layers prefer to be equidistant and the local layer normal **a** coincides with the director **n**. (b) The layer and director alignments may be perturbed from their preferred undistorted orientations in which case **a** and **n** need no longer coincide. The orientation angles θ and δ, for **n** and **a**, respectively, are measured relative to the direction of the undistorted layer normal.

Smectic A (SmA) liquid crystals are fluid, layered, materials which obey Darcy's law for flow normal to the layers and Navier Stokes equations in the other two directions [1; 2]; a schematic of the structure in undistorted and distorted configurations is given in Fig. 1. Distortions can occur either due to the influence of boundaries or because of flow, and are quantified through two orientation angles, θ and δ, that are measured relative to the direction of the undistorted layer normal.

This contribution considers the analysis of a mathematical model for flow driven by a pressure gradient applied to SmA liquid crystals between two plates in a direction normal to the layers. Asymptotic analysis quantifies the width of boundary layers in θ and δ at the plates, but also indicates the presence of a transition layer through which θ and δ change from their undistorted bulk values. Comparison is made with the corresponding analysis when there is no pressure gradient, and the analysis is then reconciled for both cases with the results of numerical computations.

REFERENCES

[1] P. G. de Gennes. Viscous flow in smectic A liquid crystals. *Phys. Fluids*, **17** 1974, 1645-1654.

[2] I. W. Stewart. *The Static and Dynamic Continuum Theory of Liquid Crystals.* Taylor and Francis, London and New York, 2004.