A continuum theory for smectic A liquid crystals

I. W. Stewart

Department of Mathematics
University of Strathclyde
Livingstone Tower
26 Richmond Street
Glasgow G1 1XH
United Kingdom

A continuum theory (1) for the statics and dynamics of smectic A liquid crystals will be presented and some applications will be given. This theory is a natural development of that introduced by de Gennes (2) and has been motivated by the work of Ribotta and Durand (3) and the recent investigations of Auernhammer et al. (4,5) and Soddemann et al. (6). Most previous continuum theories (7-9) equate the alignment of the director **n** with the local smectic layer normal **a**; the theory described here, in common with that in articles (3-6,10,11), allows **n** and **a** to differ if necessary.

Examples will include (i) the equilibrium structure of biological lipid bilayers subject to weak anchoring boundary conditions (10), and (ii) an elementary analysis of simple shear flow in planar aligned smectic A liquid crystal samples (11). The roles of some important material parameters, such as surface tension, compression modulus and weak anchoring strength, will be highlighted. Comparisons with some experimental data will also be made.

References

(1) I.W. Stewart *Continuum Mech. Thermodyn*. **2007**, *18*, 343-360
(2) P.G. de Gennes *Phys. Fluids* **1974**, *17*, 1645-1654
(3) R. Ribotta, G. Durand *J. Phys.* **1977**, *38*, 179-204
(4) G.K. Auernhammer, H.R. Brand, H. Pleiner *Rheol. Acta* **2000**, *39*, 215-222
(5) G.K. Auernhammer, H.R. Brand, H. Pleiner *Phys. Rev. E* **2002**, *66*, 061707
(6) T. Soddemann, G.K. Auernhammer, H. Guo, B. Dünweg, K. Kremer *Eur. Phys. J. E* **2004**, *13*, 141-151
(7) P.G. de Gennes, J. Prost *The Physics of Liquid Crystals* **1993**, 2nd edition (Oxford University Press, Oxford)
(8) I.W. Stewart *The Static and Dynamic Continuum Theory of Liquid Crystals* **2004** (Taylor and Francis, London and New York)
(9) W. E 1997 *Arch. Ration. Mech. Anal.* **1997**, 137, 159-175
(10) R. De Vita, I.W. Stewart *J. Phys.: Condens. Matter* **2008**, *20*, 335101
(11) F. Stewart, I.W. Stewart *to appear*