

Virga, Epifanio G.

Variational theories for liquid crystals. (English) Zbl 0814.49002

Applied Mathematics and Mathematical Computation. 8. London: Chapman & Hall. xii, 375 p. (1994).

The object of this book is to give an account of the equilibrium of liquid crystals from the mathematical point of view in the style of modern continuum mechanics. A treatment of flows is omitted as they are dissipative.

The first chapter is entitled Physical Background, and discusses the different types of liquid crystals and their general properties. The author notes that smectic materials are excluded from his treatment because of a lack of a sound theory. The second chapter, on Mathematical Preliminaries sets out the analytical tools needed for liquid crystal theory, and is mainly concerned with properties of vectors and tensors. The remaining four chapters discuss the theory of liquid crystals. The third chapter on the Classical Theory gives the continuum theory of liquid crystals, based on Oseen's work and its later developments. In addition there is a short introduction to the newer Ericksen theory. The fourth chapter, entitled Instabilities involves the behaviour of liquid crystals when affected by electrostatic or magnetostatic fields. Included is a discussion of the Fredericks and De Gennes transitions. The fifth chapter, entitled Drops, considers equilibrium shapes of a drop of liquid crystal surrounded by an isotropic fluid, and drops floating upon a substrate. The treatment is based on surface energies, and consequently the opportunity has been taken to discuss weak anchoring, where a small part of the material is in contact with a container. In the sixth chapter, the New Theory, Ericksen's theory is set out, the appropriate energy functional is developed, and it is shown how crystal defects, which previous theories failed to explain, can be treated.

This is an interesting book. Much of the work involved, as the title suggests, involves the formulation of appropriate functionals and the conditions for them to have a stationary value. There are some hundreds of references and suggestions for further reading (over 25 pages in all). Two interesting features are a number of colour plates and the reference to biological phenomena involving liquid crystals. The printing is excellent, the book reads easily, and it can be warmly recommended. It should be noted that electromagnetic quantities are measured in c.g.s electromagnetic units.

Reviewer: [Ll.G.Chambers \(Bangor\)](#)

MSC:

- [49-02](#) Research exposition (monographs, survey articles) pertaining to calculus of variations and optimal control
- [49S05](#) Variational principles of physics (should also be assigned at least one other classification number in Section 49-XX)
- [82D30](#) Statistical mechanical studies of random media, disordered materials (including liquid crystals and spin glasses)
- [35Q80](#) Applications of PDE in areas other than physics (MSC2000)

Cited in **114** Documents

Keywords:

[variational theories](#); [liquid crystals](#)