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Smectic and Columnar Liquid Crystals: Concepts and Physical Properties Illustrated by Experiments

This book is a follow up to the volume *Nematics and Cholesteric Liquid Crystals* by the same authors in the Liquid Crystal Book Series edited by G.W. Gray, J.W. Goodby and A. Fukuda. Here, the authors, two well known experts from the Ecole Normale Supérieure, Lyon and the Université Paris-Sud, deal with liquid crystalline phases endowed with long range positional order in one or more dimensions, as well as with orientational order. They do not attempt to cover all the very many smectic and columnar phases discovered to date but, as we shall see, choose instead to concentrate on certain aspects of the more common and well studied ones. The book is divided in ten chapters: the first three are on the simplest layered phase, the smectic A, and encompass its structure, hydrodynamics, dislocations, focal conics, and rheology. The nematic-smectic transition is treated within the Landau-deGennes framework and pretransitional effects, with the onset of positional correlations, are well illustrated resorting to X ray scattering experiments. Layer undulation instabilities, sound propagation, flow in A phases are also treated. Focal conics and dislocations are considered next, explaining first the characteristic polarizing microscope optical textures and then the role of these defects in interpreting the rheological features of smectics.

The fourth chapter is on ferroelectric and antiferroelectric mesophases (chiral smectic C, or C*, in particular), followed by one on twist grain boundary (TGB) smectics, one on hexatic smectics discussing two dimensional melting and the smectic I phase, and one on smectic B plastic crystals. This is followed by a rather ample (80 pages) treatment of free standing films discussing preparation, experiments and transitions at fixed number of layers as well as of smectic films as vibrating membranes and model systems for drums, billiards etc. I have found this chapter of particular interest as it covers topics that are relatively recent and less treated in other books.

The last two chapters are devoted to columnar phases and include a discussion of structure, optical properties, light scattering, elasticity, dislocations, and instabilities. The growth of a columnar hexagonal phase is tackled in the diffusive and kinetic regime.

The approach of the authors is in general that of Continuum Theory, well rooted in the French school from P.-G. deGennes pioneering work onwards. Relevant concepts are well explained and the relation to experiments emphasized. However, do not expect to find in this book much at all on the chemical, spectroscopic, or more generally on the molecular aspects of smectics and columnar phases, which are rather conspicuously absent. Even within the authors' chosen approach, the choice of topics and the depth they are treated seem to be quite personal, rather than being comprehensive, giving the reader a possibly unbalanced view of the field of smectics and columnar mesophases. For instance, the currently very important and actively studied banana phases get only a brief mention (two pages), while smectic drums get a detailed section (twelve pages). In the chapters on columnar phases the issue of directional transport and conductivity is not discussed, while it is of course a very important and actively studied topic for applications in organic electronics.

In summary, this is not a general purpose text on smectic and columnar phases, contrary to what the title might suggest. However, the book provides a useful and, for some aspects, very interesting reference for graduate students and researchers in liquid crystals physics interested in learning on the continuum theory approach to Smectic and Columnar Phases and on some of its applications.

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