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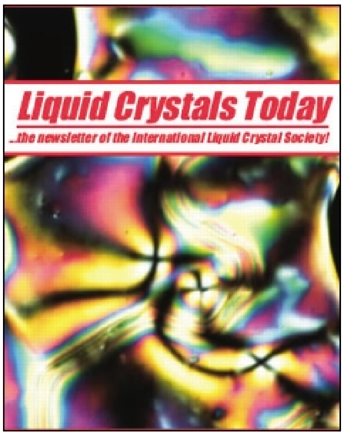

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A review of: "Liquid Cvystuls Topics in Physical Chemistry"

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taken to be r. For the distorted state, the bulk energy is $F_b \sim NKL$, while the surface energy of the uniform state is $F_s \sim NWrL$. Since $r \approx \phi^{-1/2}L$, $F_s/F_b \sim \phi^{1/2}L/l_e$, one finds a critical mesh size $L = \phi^{-1/2}l_e$ below which a uniform director field $\hat{\mathbf{n}}(\mathbf{r}) = const.$ appears favoured.

We point out, however, that even for very small mesh sizes L, we do not expect true long range uniform alignment. In accordance with the random field arguments of Imry and Ma [10], long range order is destroyed by random fields such as surface interactions in dimensions $d \leq 4$. In our case, this comes about because long wavelength distortions of the director field have a vanishingly small energy cost: these are therefore still imposed by the random medium. We argue, however, that in systems whose characteristic length L is smaller than the extrapolation length l_e, large nematic domains with nearly uniform alignment can form. The domain size R may be comparable to the sample size, and we suppose R to be of the form:

$$\frac{R}{l_e} \approx \frac{l_e}{L} + \frac{L}{l_e}$$

Our conclusions about the existence of uniform macroscopic structures do not mean only that weak anchoring cannot compete with the elastic forces and the individual nematic subvolumes are uniform. We argue the more subtle point: for systems with characteristic lengths smaller than the extrapolation length., the connectivity of the nematic volume makes the entire system uniform, since the elastic energy saved is greater than the penalty for surface misalignment.

A number of experiments suggest themselves to verify the above arguments. The characteristic size R of liquid crystal domains in heterogeneous materials should behave non-monotonically with the effective length scale L of the heterogeneity; $R \sim L$ for $L > l_e$, but diverges for $L << l_e$, until it reaches the sample size. In this latter 'monocrystal' state, the system should exhibit long correlation lengths and relaxation times, and increased sensitivity to orienting external fields. Indications of such behaviour may already have been observed in recent experiments [2,5].

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Review of

Liquid Crystals Topics in Physical Chemistry

Edited by H, Stegemeyer, Steinkopff Verlag, Darmstadt, 1994, X, 231pp, Hardcover
DM 44.80, ISBN 3-7985-0924-7

by J.W. Emsley, Department of Chemistry, University of Southampton

One of the joys of doing research on liquid crystals is the interdisciplinary nature of the subject, but this also makes it difficult for those new to the topic. Introductory texts have a hard task since they should include something about chemical structure and structure-property relationships, something on the macroscopic physics, and perhaps too, something on electro-optic devices. And all this has to be digestible to scientists and engineers with diverse backgrounds. This collection of articles assembled by Stegemeyer is a welcome attempt to satisfy these constraints. It comprises six chapters, each by a different author. Demus introduces the polymorphism of liquid crystals and gives a detailed description of most of the thermotropic phases and discusses the influence of chemical structure on phase stability. Petzl deals with the macroscopic physics, such as the elastic constants, viscosity, and the effect of applying electric and magnetic fields. Zentel describes liquid crystal polymers, and Hiltrop deals with lyotropic systems. Pohl describes some of the uses of liquid crystals as solvents in spectroscopy, and finally Schadt describes liquid crystal displays.

The aim of an introductory text should be to introduce the reader to a body of knowledge, and to the main principles which are invoked to explain observations. From this point of view, I found the articles by Zentel and Schadt to be excellent, and in particular they both bring the reader fully up to date. Of the other chapters, only that by Pohl seriously disappoints. It is different in kind from the rest of the book, being concerned with how using a liquid crystal as a solvent can be exploited in spectroscopy, rather than how spectroscopy can be used to study liquid crystals.

In Southampton we offer a course on liquid crystals to our final year undergraduates, and in the absence of a suitable introductory text, we give a wide reading list. This book will certainly feature high on this list as being perhaps the best yet available.