The enchanting soft material

Liquid Crystals: Applications and Uses. Three volumes. Birendra Bahadur (ed.). World Scientific, Farrer Road, P.O. Box 128, Singapore 912805. 1992. 1408 pp.

Liquid crystals as exotic materials attracted the attention of scientists in the late fifties though they were discovered in the last century. The unique feature of liquid crystals is the existence of orientational order, which in some cases is accompanied by a lattice order as well. They happen to possess a degree of molecular aggregation inbetween that found in liquids and crystals. Liquid crystals have become very important in two respects. Firstly, they are ideal and easily accessible systems to verify and demonstrate concepts and ideas generated in other forefront areas of condensed matter physics. Secondly, being 'soft' materials, they can be easily distorted by the application of weak electric or magnetic fields. In fact, many of the technological applications of liquid crystals are due to the latter characteristic property.

The very first display application of liquid crystals was in the fabrication of the dynamic scattering displays which have now become obsolete and are only of historical importance. Liquid crystal displays (LCDs) have become very prominent amongst the various types of flat panel displays, specifically in the computer industry. In this context, the efforts of Bahadur in bringing out these three volumes on the applications of liquid crystals, are to be appreciated. These volumes have reviews covering a wide spectrum of topics written by practitioners of liquid crystals.

As implied by the title of the series, the majority of articles are on LCDs. This subject has been dealt with in about a dozen reviews. Morozumi's article gives useful tips on the actual techniques involved in the fabrication of displays. The article by Dijon describes in detail every aspect of fast ferroelectric displays. This has potential applications in computer and television displays. Doane's article is about large and flexible polymer-dispersed LCDs. They allow more light to pass through since polarizers are not used as in other LCDs. At present, twisted nematic displays and their variations have captured most of the flat panel display market in the world. The article by Scheffer and Nehring brings out the essential features of these displays. Luo has emphasized the fabrication technology behind the active matrix LCDs which are useful in displaying high information contents. These are also emerging as replacements to cathode ray tubes. Shields and Bleha's review on the analog and matrix-addressed light valves, projection optics as well as on projection screens is useful to those interested in large sized displays. Clark and Johnson discuss applications of liquid crystals in optical computing which has great potential. Kobayashi and Mochizuki in their review consider the other upcoming LCDs. The review on 'Display parameters and requirements' by Bahadur covers amongst other things, the failures and flaws in LCDs. The reliability and accelerated life tests described here are important from a practical point of view.

There are also articles on the other important applications of liquid crystals. The review by Khetrapal *et al.* highlights its applications in molecular structure determination by nuclear magnetic resonance. Witkiewicz discusses about these materials acting as stationary phases in chromatography, more importantly as capillary chromatographic columns. Leigh dwells upon liquid crystals as media to elucidate chemical reaction mechanisms. The review by Makow on their applications in visual arts mainly describes the optics of cholesteric liquid crystals and does not stress issues of relevance to one practising such arts. Friberg's write-up is on some interesting uses of lyotropic liquid crystals in emulsions and foams.

The background material necessary to appreciate these applications has been covered in reviews which deal with a) classification, b) molecular structure c) phase diagrams, d) effects of external fields, e) nonlinear optics and f) molecular theories. The review by Coates on mixtures has important and useful information pertaining to materials possessing parameters of significance to displays. In practice, a pure compound with requisite parameters is very difficult to synthesize. Hence mixtures have been used instead. The article by Chapman on the structures and properties of liquid crystalline forms found in biological systems, would be of general interest.

A drawback of this series is that the various reviews are not well arranged to develop the subject methodically from basics to applications. It would have been more useful to a beginner if the series had included a chapter discussing the relative merits of the various types of LCDs. However, in our view, these volumes can still serve as an useful series for reference by researchers interested in liquid crystal displays.

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Erratum

Recent finds of ancient gold mining sites in South Uttar Pradesh (*Curr. Sci.*, 1995, 69, 634–635)

The last sentence in the article should read 'The age of gold mining is pre-Mauryan and might be pre-2400 BC (ref. 2)' and not as printed.

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