Statistical Theory of Elastic Constants of Cholesteric Liquid Crystals

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A statistical theory of cholesteric liquid crystals composed of short rigid biaxial molecules is presented. It is derived in the thermodynamic limit at a small density and a small twist. The uniaxial (biaxial) cholesteric phase is regarded as a distorted form of the uniaxial (biaxial) nematic phase. The chirality of the interactions and the implementation of the inversion to the rotation matrix elements are discussed in detail. General microscopic expressions for the elastic constants are derived. The expressions involve the one-particle distribution function and the potential energy of two-body short-range interactions. It is shown that the elastic constants determine the twist of the phase. The stability condition for the cholesteric and nematic phases is presented.

The theory is used to study unary and binary systems. The temperature and concentration dependence of the order parameters, the elastic constants and the twist of the phase are obtained. The possibility of phase separation is not investigated.

Key words: Liquid Crystals; Cholesterics; Elastic Constants; Mixtures.