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Phase Transitions and Elastic Properties of Liquid Crystals

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ABSTRACT

Mesogenic materials exhibit a multitude of transitions involving new phases. Studies of these phases are of importance in a wide range of scientific fields and as such have stimulated considerable theoretical and experimental efforts over the decades. A range of problems and questions related to mesophase transitions will be identified. The application of various theories (hard particle-, Maier-Saupe-, van der Walls type, and density functional) to the description of isotropic - nematic and nematic - smectic A transitions will be discussed in brief.

A detail analysis of the effect of pressure on the electric – field induced phase transitions in liquid crystals which exhibit isotropic - smectic A and isotropic - nematic - smectic A transitions will be presented within the framework of Landau & de Gennes formulation. The pressure driven reentrant phenomena that is $N - S_A - N_R$ phase sequence which is observed in some mesogenic material is addressed in the above phenomenology. The role of pressure dependent parameters such as metastable temperature and couplings parameters between nematic and smectic phases will be discussed.

The order existing in liquid crystals has interesting consequences for their elastic behavior. The key problems will be identified. The elastic continuum description of uniaxial (nematic and smectic A) and biaxial (nematic and smectic C) phases will be given. A unified **first-principles microscopic theory**, based on weighted density functional formalism, for the elastic free-energy density as developed by us will be described. The application of this theory to the above mesophases will be considered. The numerical results obtained for the elastic constants of the uniaxial nematic phase will be compared with its experimental values.