Quadrupolar and Octupolar Interactions and Stability of Chiral Phase in Lattice Model of Bent–Core Liquid Crystals

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The main aim of this study is a demonstration that quadrupolar and octupolar microscopic interactions stabilize globally a homogeneous chiral phase. Investigated model is a generalization of Lebwohl–Lasher type of anisotropic interactions. Presented results are obtained within the Mean-Field theory and Monte Carlo simulations. Phase diagrams include the following structures: isotropic (I), uniaxial (N_U) and biaxial (N_B) nematic phases, tetrahedratic phase (T), D_{2d}–symmetric tetrahedratic nematic phase (N_T), and chiral tetrahedratic nematic (N_T^*) phase of D_2 symmetry. The mechanism responsible for stabilizing N_T^* and N_T structures is interplay between quadrupolar and octupolar interactions. Furthermore, one of the phase diagrams displays a multicritical Landau point where all aforementioned phases meet. The inclusion of higher–order cross–couplings between uniaxial, biaxial and tetrahedratic interactions can superimpose a spatial modulation to the homo–chiral order of N_T^* and to N_T. Thus the new structures found can serve as the long–wavelength limit to a family of spatially modulated chiral structures that can possibly condense in the bent-core systems. Owing to general form of the interaction we use these conclusions should apply to any system where tetrahedratic and quadrupolar order may simultaneously coexist.

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