Cristian V. Achim
Department of Applied Physics, Aalto University School of Science,Finland
e-mail: criaro@gmail.com

Phase Field Crysyal Model for Liquid Crystals

On the basis of static and dynamical density functional theory, a phase-field-crystal model is derived which involves both the translational density and the orientational degree of ordering as well as a local director field. The equilibrium free-energy functional involves local powers of the order parameters up to fourth order, gradients of the order parameters up to fourth order, and different couplings between the order parameters [1]. The stable phases of the equilibrium free-energy functional are calculated for various coupling parameters. Phase diagrams were obtained by numerical minimization of the free-energy functional. Among the stable liquid-crystalline states are the isotropic, nematic, columnar, smectic A, and plastic crystalline phases [2]. The plastic crystals can have triangular, square, and honeycomb lattices and exhibit orientational patterns with a complex topology involving a sublattice with topological defects. As far as the dynamics is concerned, the translational density is a conserved order parameter while the orientational ordering is non-conserved. The derived phase-field-crystal model can serve for use in efficient numerical investigations of various nonequilibrium situations in liquid crystals.

References

[1] H. Löwen, *A phase-field-crystal model for liquid crystals* J. Phys.: Condens. Matter **22** (2010) 364105 1–6.

[2] C. V. Achim, R. Wittkowski and H. Löwen, *Stability of liquid crystalline phases in the phase-field-crystal model* Submitted to Physical Review E.