Field-induced twist-bend distortion in mixtures of chiral and achiral molecules

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We present a mean field theory to describe phase transitions in binary mixtures of a chiral and an achiral liquid crystalline molecule in the presence of an external field. When a longitudinal external field is applied parallel to the pitch axis of the cholesteric (N*) phase, the director of the N* phase can lead to an oblique heliconical cholesteric (C_{OH}) with a twist-bend distortion [1,2], due to the coupling between the external field and the director. We predict that the C_{OH} phase exists between N* and nematic (N) phases on the temperature-concentration plane. We find various phase transitions: the first-order C_{OH}-I(isotropic) and the second-order N-C_{OH}, C_{OH}-N* phase transitions. We also predict the phase diagrams, depending on temperature and concentration under the external field.

Figure 1 shows the phase diagram on the temperature T/T_{NI} and the external field h plane for the volume fraction ϕ_A of the chiral molecules: ϕ_A=0(black), ϕ_A=0.1 (red) and ϕ_A=0.5 (blue) . The solid curves show the second-order phase transitions: N-C_{OH} and C_{OH}-N* transitions. The dotted-curves show the first-order phase transitions: I-N, I-C_{OH}, and I-N* transitions. The closed circles show the critical point (CP).

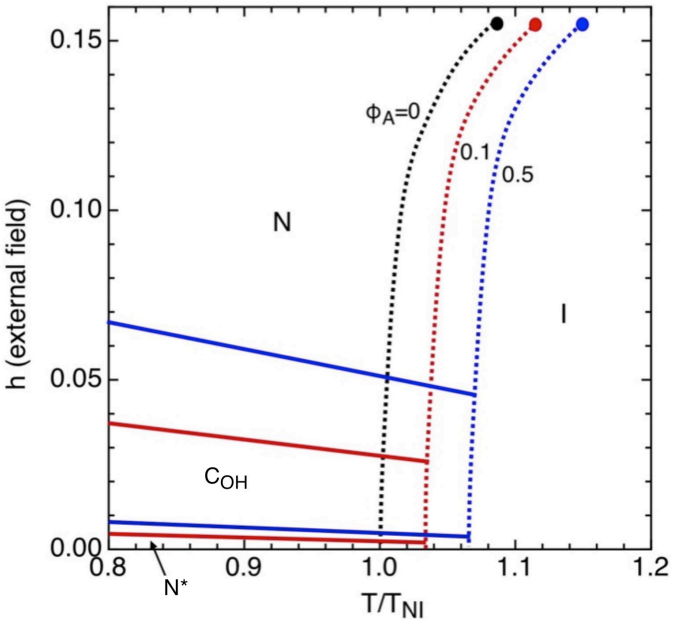

Figure 1 Phase diagram on the temperature T and external field h plane for various concentrations of chiral molecules.

References

[1] A. Matsuyama, Liq. Cryst. 43, 783-795 (2016);
[2] A. Matsuyama, J. Phys. Soc. Jpn. 85, 114606(1-9), (2016).