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Phase Sequences and Phase Transitions into the Ferroelectric Smectic A-Phase

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The recent discovery of the ferroelectric nematic phase (N_F) has opened up a new field in soft matter research. Within a few years, new polar phases with smectic order were discovered, such as SmA_F, SmC_F and SmC_P^H. [1–3] These polar smectic phases often form directly from the N_F phase on cooling, indicating that polar order develops prior to the appearance of smectic layering in these cases. In contrast, only a few materials are known to follow the sequence N → SmA → SmA_F on cooling, in which the smectic layer structure forms before the onset of polar order. [4]
In this contribution, we will examine the question of how the sequence in which smectic and polar order develop affects the SmA_F phase. We compare the three LC mixtures (M1, M2 and M3), two of which (M1 and M2) exhibit the phase transition N_F → SmA_F and one of which (M3) the less common SmA → SmA_F transition. Depending on the phase sequence, we observed characteristic differences in the polarized optical microscopy (POM) textures of the SmA_F phases (see Figure 1), in the temperature dependence of their smectic layer spacings $d(T)$ and in the thermodynamic nature of the phase transitions.

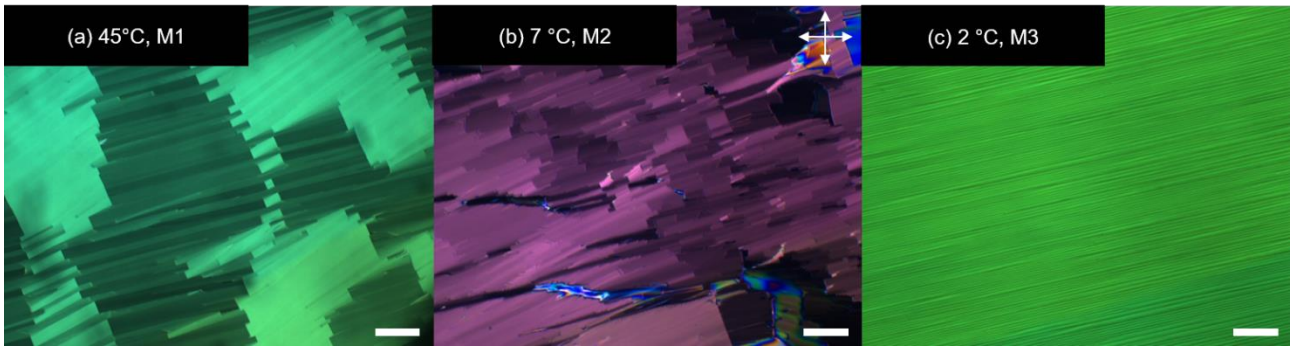

Figure 1. Optical photomicrographs of the SmA_F phase of the materials M1 (a), M2 (b) and M3 (c) in 3.5 µm antiparallel rubbed cells. Scale bar 200 µm.

References

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