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Field-Driven Texture Evolution in a Ferroelectric Smectic A Phase

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A polar smectic A-phase (SmA_F), discovered in 2022 in mixtures of ferroelectric nematic compounds [1], combines the polarity of the ferroelectric nematic phase (N_F) [2] with a 1D-layered structure, resulting in an even higher degree of polar order. This phase exhibits high spontaneous electric polarization along the polar director perpendicular to the layer planes. Little is known about the properties of this polar smectic phase, particularly its switching behavior. While some examples of field-induced switching in the SmA_F phase have been reported, it remains unclear how polarization reversal in an electric field is compatible with the layer structure.

In this study, we now investigate the polarization dynamics of the ferroelectric smectic A-phase, focusing on textural transformations. When a weak electric field at low frequency is applied, the initially observed striped texture undergoes a dramatic change into a kind of Schlieren texture, raising the question of whether the resulting state is smectic C-like with a transient tilt of the director. This contribution aims to shed light on the nature of this field-driven transformation and how it can be understood on a molecular level.

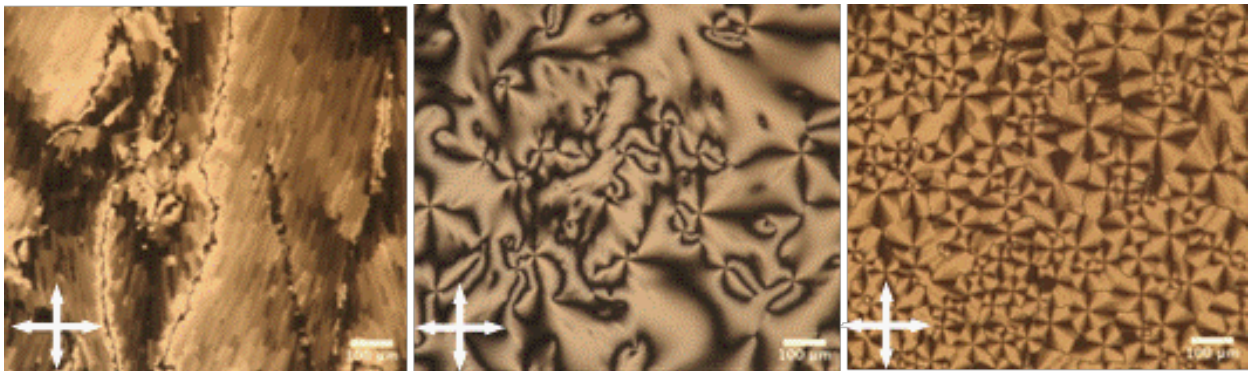

Figure 1. Textures of an FNLC mixture (50:50 wt% AUUQU-2-N : DIO) in a bare 1.6 µm ITO-sandwich cell at 25 °C. Left: Virgin SmA_F texture before applying an electric field. Center: Schlieren texture with triangle-wave voltage (10 Hz, 4 V) applied to the SmA_F phase. Right: SmA_F texture after switching off the electric field (10 Hz, 10 V). (Scale bars: 100 µm).

References

[1] X. Chen, V. Martinez, P. Nacke et al., *Proceedings of the National Academy of Sciences*, **119**, *47* (2022)
[2] P. Nacke, A. Manabe, M. Klasen-Memmer et al., *Scientific reports*, **14**, *4473* (2024).

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