Complex liquid crystal geometries created by periodic photo-alignment

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Photo-alignment by polarized UV light is a powerful non-contact method to align nematic liquid crystal. The mechanism of photo-alignment is based on the isomerization of azo-based compounds and leads to the alignment of the director, perpendicular to the polarization of the UV light. A variable azimuth of linearly polarized light can for example be obtained by the interference of two circularly polarized beams with opposite handedness. By writing different periodic alignment patterns on the two substrates, complex three-dimensional director patterns can be formed in the bulk [1]. Another option is to use a mixture of homeotrophic and photo-alignment material illuminated with a periodic pattern. The resulting linear pattern of alternating strips of planar and homeotropic alignment at the two substrates leads to complex finger patterns when the volume between the substrates is filled with chiral liquid crystal. Microscopic images are analyzed by comparison with finite element Q-tensor simulations.

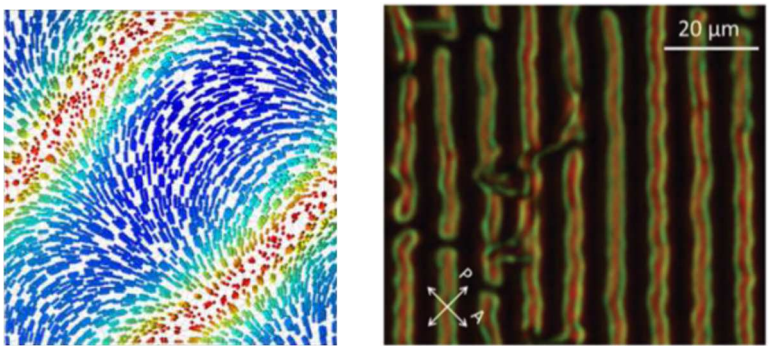

Figure: Left: Simulated mid-plane director for nematic LC between substrates with periodic rotation of the alignment at top and bottom. Right: Finger patterns formed by chiral liquid crystal between substrates with periodic planar/parallel alignment, observed with polarization microscopy.

[1] Nys I. , Beeckman J., Neyts K., "Switchable 3D liquid crystal grating generated by periodic photo-alignment on both substrates," Soft Matter 2015, 11, 7802.
[2] Nys I. , Chen K., Beeckman J., Neyts K., "Periodic Planar-Homeotropic Anchoring Realized by Photoalignment for Stabilization of Chiral Superstructures," Adv. Opt. Mater. 2018, 1701163.