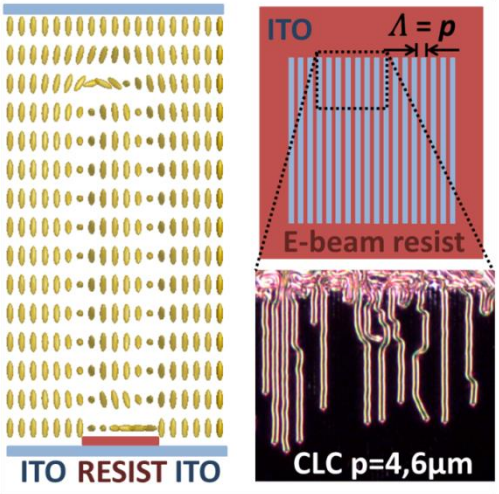
Controlled formation of chiral liquid crystal superstructures by periodic modulation of the surface properties

Inge Nys, Jeroen Beeckman, Kristiaan Neyts

Liquid Crystals and Photonics Group, Ghent University



The liquid crystal (LC) director configuration in a confined geometry depends on a delicate balance between surface anchoring, elastic energy and, if an electric field is applied, dielectric energy. Changing this equilibrium allows to obtain novel LC superstructures and can stimulate the development of electro-optic devices with improved characteristics. We developed two different techniques to periodically modulate the surface properties and used these to stabilize complex chiral LC structures.

The first technique uses photoalignment to obtain periodic stripes with planar and homeotropic anchoring.[1] We demonstrated that these stripes with variable anchoring can stabilize cholesteric fingers in cells with a thickness smaller than the pitch. The resolution of the photoalignment method is ultimately limited and therefore we also developed a second technique that makes use of electron-beam lithography.[2] The lithography is performed on ITO covered glass substrates and after resist development the substrate can be used without additional processing steps. Both long (p = 4.6 µm) and short (p = 340 nm) pitch CLC structures were aligned with the help of a periodic surface structure at one of the confining substrates. By matching the period of the e-beam grating with the pitch of the CLC, new chiral superstructures were stabilized. The directional growth of the chiral superstructures along the grating stripes can be controlled by applying a voltage to the cell. The 2D director configuration for different voltages was identified by finite element Q-tensor simulations.

[1] Nys, I., Chen, K., Beeckman, J. & Neyts, K.; Periodic Planar-Homeotropic Anchoring Realized by Photoalignment for Stabilization of Chiral Superstructures.; Adv. Opt. Mater.; 1701163; 2018.

[2] Nys, I., Beeckman, J. & Neyts, K.;. Surface mediated alignment of long pitch chiral nematic liquid crystal structures; Adv. Opt. Mater.; accepted for publication 2018.