Defect dynamics of bistable latching

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The zenithal bistable device is a bistable nematic device which includes a surface relief grating giving two mutually stable director alignments. The high tilt state is known as the continuous (C) state, and the low tilt as the defect (D) state due to the $\pm {}^{1}/_{2}$ disclinations at the top and bottom of the grating grooves (see Figure 1). Latching between the states can be achieved through application of bipolar pulse waveforms. The polarity of the trailing pulse chooses the latch state: negative for continuous, positive for defect. This polar response is critical to latching between bistable states and is a result of the flexoelectric effect.

Due to the scale of the defects and the fast switching speeds, the precise mechanism for latching is not observable through experimental techniques. In this paper we explore the defect dynamics during latching in either direction using computational modelling.

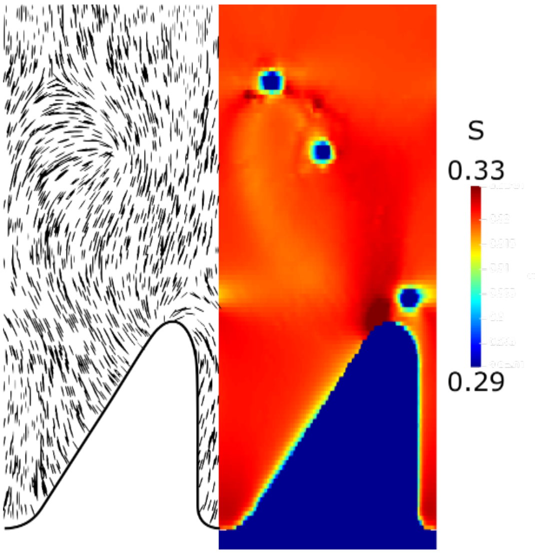

Figure 1: Director configuration and map of order parameter for second-generation defect nucleation, as seen on application of a 2.5 ms, 12.5 V bipolar latching pulse.

QLC3D[1] is a three dimensional finite element model to solve the Q-tensor field in small scale LC devices. It has been used previously to model nematic bistability[2,3]. In this work it was used to model a 5 µm ZBD operating in VAN/HAN (homeotropic surface opposing the grating). LC values were taken from Spencer *et al.*[4], which represent Mixture B from Jones *et al.*[5]

We find good agreement of the modelled device performance to that of experiment. In defect-to-continuous latching, the defects are annihilated by meeting on the sidewall, as expected. In continuous-to-defect latching, we find unique defect dynamics which help to illuminate previously unexplained experimental behaviour. This includes the nucleation of a second generation of latching defects.

References

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