Measure of the flexoelectric polarisation in different nematic liquid crystal materials using an interferometric method

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Programmable liquid crystal phase diffraction gratings have potential uses for projection displays and for all optical routing switches in optical telecommunications [1]. A phase grating can be created in a planar nematic layer by applying a spatially periodic voltage in the plane of the layer via an interdigitated electrode geometry. The diffraction efficiency of such devices is severely reduced at low pitches because the phase profile is "smoothed out" by the action of fringing electric fields in the regions between the electrodes which are coupled to the elastic distortion of the nematic liquid crystal [2-4]. We have previously shown how the influence of the flexoelectric polarisation on the distortions in these regions can be used to determine the sum of flexoelectric coefficients ($e_1 + e_3$) [5,6].

In the current work we have analysed a number of materials that have different values for the dielectric anisotropy. The phase profile produced by the periodic distortion in the nematic layer in each case is measured from the displacement of tilt fringes that it produces in a Mach-Zehnder interferometer. Materials with higher dielectric anisotropy tend to suffer from having higher levels of ionic contamination. Measuring these distortions in response to a d.c. voltage that undergoes periodic changes in polarity allows the influences of the flexoelectric polarisation and the ionic contamination to be separated to some degree. For one of the materials the study has been extended to investigate how these two influences change as a function of temperature.

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