SHORT-PITCH FERROELECTRIC LIQUID CRYSTAL MIXTURES

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Depending on the molar fraction in some specific components, FLC-mixtures with a broad variety of pitch length can be created, e.g. as a minimum 0.15 μm, covering the whole optical wavelength region [1]. They show very low viscosity and low response time. The temperature range for the SmC* phase can be very broad in between -10°C to 80°C. This allows electrooptical experiments in an extended optical wavelength region and in a broad temperature range.

By applying electric field, not high enough to unwound the helix but disturb it, the birefringence can be tuned. The so-called Deformed Helix Ferroelectric (DHF) Liquid Crystal effect is demonstrated mainly on such short pitch FLCs. For this effect, a small external electric field E applied perpendicular to the helix can influence the uniform distribution. This gives rise to an effective birefringence adjustment and is the basis for applications of the DHF effect. The electrooptical response of DHF effect has been investigated at small driving voltage and drawback of the DHF effect is the longer switching time needed, since the electric field of helix unwinding $E_u$ is small at low frequencies $f$, $E_u = 0.2 -2 V/\mu m$ at $1Hz < f < 1kHz$. Recently, however, by applying higher frequency external fields of about 100 kHz and driving voltages of about 10 V on a cell with a thickness of about 2 μm, a very low switching time of the order of 1-2 μs, which is practically independent on temperature in the region of 20 °C - 80 °C, was reported [2]. At low frequencies were the common DHF effect hold, the response time is about 100 μs but decreases by increasing the frequency in the inverse relationship. The inverse electrooptical response time is shown as...
function on frequency. It is further seen that the tilt angle decreases exceeding about 1 kHz, what at the same time is a drawback.

![Graph showing temperature dependencies of the electrooptical response time \( \tau \) and switchable angle \( \theta \).]

Fig. 1 Temperature dependencies of the electrooptical response time \( \tau \) and switchable angle \( \theta \): in DHF mode at \( f=130 \) kHz and \( E=\pm15 \) V/\( \mu \)m (curve 1); in bulk switching mode at \( f=10 \) kHz and \( E =\pm15 \) V/\( \mu \)m (curve 2). Temperature dependence of the tilt angle \( \theta \) in DHF mode at \( f=130 \) kHz and \( E =\pm15 \) V/\( \mu \)m (curve 3); in bulk switching mode at \( f=10 \) kHz and \( E =\pm15 \) V/\( \mu \)m (curve 4). The electrooptical cell with FLC cell thickness 2 \( \mu \)m based on FLC-388 (\( \approx0.22 \) \( \mu \)m at \( T=20^\circ\)C) was used for measurements.

We also present dielectric measurements and switching experiments. The spontaneous polarization determined is rather high. This gives rise to prove the type of switching.

The electrooptical response under light illumination has been detected. Triangular and rectangular pulses were applied. The modulation of the transmitted light due to scattering could be monitored.

References: