Testing the parallelism of the plates of a display-like nematic liquid crystal cell by NMR

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We describe a NMR technique allowing for an accurate evaluation of the degree of parallelism between the two planar plates of a display-like liquid crystal cell. It is based on the response of a nematic liquid crystal subjected to both a magnetic field and an electric field in an orthogonal geometry. In the ideal set-up the two plates are assumed to be rigorously parallel and immersed in the magnetic field of the NMR spectrometer. An electric field is applied normal to the plates and these are parallel to the field of the spectrometer. For this ideal geometry there exists a threshold value of the electric field for which the effect of both fields exactly compensate in the whole sample; for stronger electric field the director aligns with the electric field while for weaker electric field the director aligns with the magnetic field of the spectrometer. If some lack of parallelism between the two plates exists, the electric field may be larger than the threshold value in some region of the sample and smaller in the remaining part of the sample. Accordingly, the director will adopt essentially two orientations within the sample, namely parallel or normal to the magnetic field, which will clearly reflect on the NMR spectra. The coexistence of two director populations will be observed for a range of values of the electric field that depends on the degree of non-parallelism of the plates; accordingly, an evaluation of this range by deuterium NMR investigation yields an experimental estimate of the degree of parallelism of the plates and provides a way to improve it. We will present the basic theory of the method and some computer simulations and experimental results supporting it.

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