

Optical simulations and measurements on a new reconfigurable liquid crystal wave plate

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Recently a novel liquid crystal device based on a four-electrode unit, arranged in a hexagonal array as shown in the figure was presented. The electrodes are addressable in four different groups, indicated with different grey levels. Addressed in pairs of 2 by 2, the electrodes at equal potential form parallel lines comparable to the in-plane switching mode of liquid crystals (see figure). In this way, the director can be aligned along three different directions in the plane parallel to the substrate surfaces.

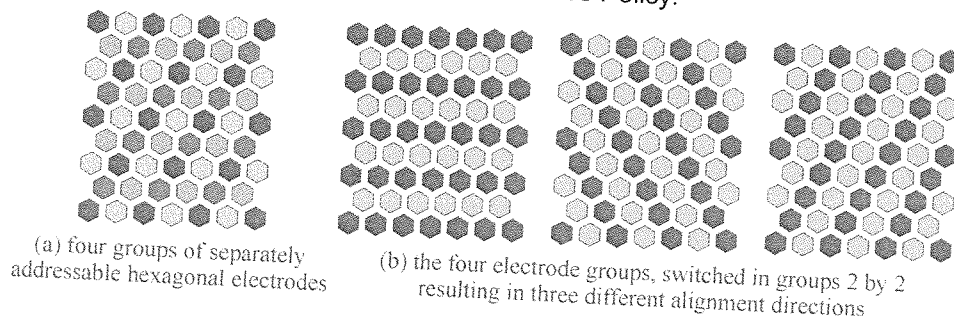
Full three-dimensional simulations have been published in the reference below, using a finite elements algorithm and demonstrating three stable orientations of the director in the plane parallel to the substrate surface.

In this work we compare the simulations with measurements of the device. The constructed device consists of a layer of regularly shaped hexagonal electrode pads on the underside of a stack comprising a dielectric layer and a liquid crystal layer, sandwiched between two glass substrates. The dielectric layer in between the electrodes and the liquid crystal shields the strong vertical components of the electric field, which tend to destroy the horizontal alignment of the liquid crystal. The hexagonal electrode pads in the constructed device have a side length of 5 μm and are spaced 3 μm apart. The dielectric layer was made with the polymer benzocyclobutene (Cyclotene) and has a thickness of 1 μm . The liquid crystal material used is E7, with a thickness of 2.1 μm . The surfaces in contact with the liquid crystal are treated with the surfactant FC4430 (3M) to have a low azimuthal anchoring, essential for horizontal rotation of the director.

From the numerical simulations and the experimental results can be concluded that the device works as expected.

Reference: C. Desimpel, J. Beeckman, H. Desmet, K. Neyts, R. James, F.A. Fernández, A four-electrode liquid crystal device for 2π in-plane director rotation J. Phys. D-Appl. Phys., 2005, 38, 3976-3984

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ABSTRACTS

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