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Simulated near field and diffraction patterns in the cholesteric layers with conical surface anchoring

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The periodic domain pattern observed when a DC or low frequency AC electric field is applied to a nematic liquid crystal is called Williams domain (WD) [1]. The reason for WD is electrohydrodynamic instability of the liquid crystal with negative dielectric anisotropy ($\varepsilon_\parallel < \varepsilon_\perp$) but positive conductive anisotropy ($\sigma_\parallel > \sigma_\perp$) [2]. In this case, the periodic WD structure acts as a diffraction grating. If the polarization of the incident light lies in the director plane, then a diffraction pattern appears on the screen with the distribution of maxima and minima along the line, parallel to the director near the substrate. The calculation of the spectral properties and the far field distribution of such structures is a time consuming task. In this regard, we have considered the possibility of using the Finite-Difference Time-Domain (FDTD) method [3] for calculating the far field distribution of such domain structures.

The optical properties of 4-metoxy- benzylidene-4'-butylaniline (MBBA) nematic liquid crystal cells with thickness $d = 11.7$ μm and WD period $P = 16.7$ μm are investigated [4]. The refractive indices of nematic liquid crystal are $n_e = 1.7526$ and $n_o = 1.5477$ (t = 23°C, λ = 632.8 nm) for the light polarized parallel and perpendicular to the director, respectively. At 6 V WDs are formed.

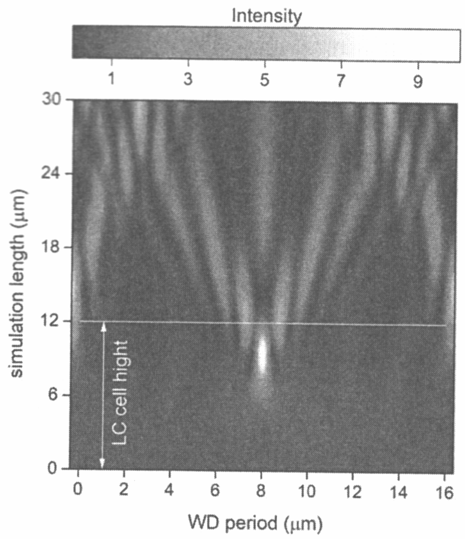

Fig.1 FDTD simulated near field distribution for Williams domains in MBBA.

Fig. 1 shows near field distribution for the studied structure and strong microlens effect at WD along with phase retardation. It means that energy flows bias from vertical direction. Convection leads to the spatial periodicity of the LC refractive index and thus modulation of the light field phase on an output mirror. The diffraction patterns of the studied structure are obtained experimentally and calculated by FDTD method. We expect the presented method fits simulation of orientation structures in the cholesteric layers with conical surface anchoring.

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