

# **Electrically-controlled two-dimensional gratings based on layers undulations in cholesteric liquid crystals**

Bohdan Senyuk<sup>1,\*</sup>, Ivan Smalyukh<sup>2</sup>, Oleg Lavrentovich<sup>1,2</sup>,

<sup>1</sup>Chemical Physics Interdisciplinary Program and <sup>2</sup>Liquid Crystal Institute,  
Kent State University, Kent, OH, USA 44242-0001

## **ABSTRACT**

## **2. EXPERIMENTAL**

### **2.1. Cell preparation and materials**

The LC cells for 2D cholesteric gratings (Fig. 1) were constructed from glass substrates coated with transparent indiumtin-oxide (ITO) patterned electrodes. The unidirectionally buffed thin layers of polyimide PI2555 (HD MicroSystem) were used to set the easy axis for LC molecules at the confining glass plates; we used different rubbing

The LC cells (Fig. 1) were filled with cholesteric mixtures (Table 1) in the isotr

of oily streaks (Fig. 3). In order to prevent nucleation at the cell edges, the transparent electrodes were patterned (Fig. 1) with the working area being  $25 \text{ mm}^2$ . This allows us to avoid the oily streaks by eliminating the nucleation sites such as surface irregularities, mechanical impurities, and strong layers distortions at the cell edges. The obtained 2D undulations were stable in time without being spoiled by the oily streaks.

$$m = L_g \sin \theta \quad (1)$$

where  $m$  is the diffraction order, and  $L_g$

period  $L_u/2$  and the beams “ $s$ ” (Fig. 4(b)) are caused by modulation of refractive index close to surfaces with period  $L_u$ . When  $d/p$  is large, the contribution from the regions close to the surfaces is negligib







12. Anup K. Ghosh, Yoichi Takanishi, Ken Ishikawa, and Hideo Takezoe, Youshiyuki Ono, Joji Kawamura, "Electrically controllable polarization-dependent phase grating from photocurable liquid crystals," *J. Appl. Phys.* **95**(9), 5241-5243, 2004.
13. B. I. Senyuk, I. I. Smalyukh, O. D. Lavrentovich, "Switchable two-dimensional gratings based on field-induced layer undulations in cholesteric liquid crystals," *Opt. Lett.* **30**(4), 349-351, 2005.
14. I. I. Smalyukh, S. V. Shiyanovskii, and O. D. Lavrentovich, "Three-dimensional imaging of orientational order by fluorescence confocal polarizing microscopy," *Chem. Phys. Lett.* **336**, 88-96, 2001.
15. T. S. Lubensky, "Hydrodynamics in cholesteric liquid crystals," *Phys. Rev. A* **6**, 452-470, 1972.
16. P.G. de Gennes and J. P002.O,