Reflective flat optical components using photo-patterned chiral liquid crystal

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Flat optical components make it possible to replace traditional lenses or prisms with much thinner alternatives. One of the approaches to realize such components is by varying the optical axis in a thin film. In this work, a thin layer of chiral liquid crystal (CLC) is used and the optical axis is oriented by photo-alignment with ultra-violet light. Since CLC spontaneously forms periodic helical structures, these components are reflective at a certain wavelength range for circularly polarized incident light. This property allows realizing optical axis variations on a very small scale without degrading the efficiency. To realize a diffraction grating, the pattern shown in Fig. 1(a) is formed on the glass surface coated with an azo-based photo-alignment material using interference between two circularly polarized beams. Such diffraction gratings are only few micrometers thick and similar optical components with large periods and high efficiency were already reported in the literature.[1] Similar method is also used for the fabrication of a lens. In this work, simulations of the director configuration and diffraction properties of the components are first performed. Then, optical components are realized, including diffraction gratings with period smaller than 2 micrometers (Fig. 1(b)) allowing efficient diffraction at large angles.

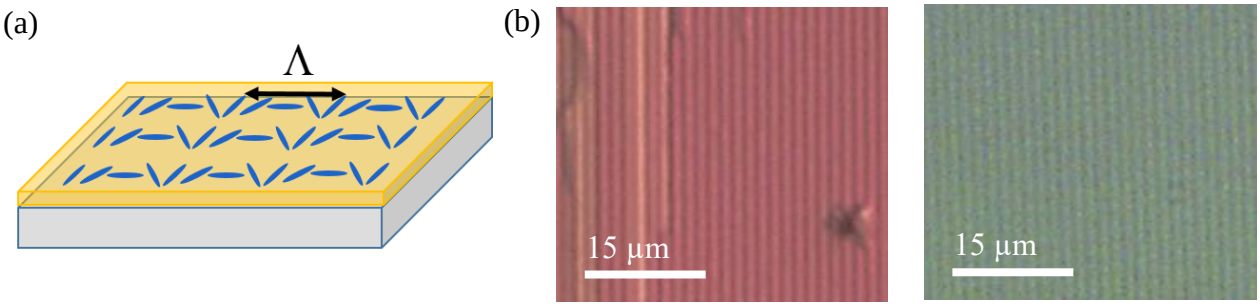

Figure 1: (a) A pattern of optical axis variation for diffraction grating with a period Λ; (b) reflection (left) and transmission (right) microscope image of diffraction grating with period 1.5 µm.

[1] Kobashi J., Yoshida H., and Ozaki M., Planar optics with patterned chiral liquid crystals, Nature Photonics **10**, 389-392 (2016).