Title: Flat optical components using photo-patterned nematic and chiral liquid crystal

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Keywords: Flat optical components, Liquid crystals, Optical simulations

250-word abstract for technical review:

Miniaturized flat optical components have become essential in all kinds of applications: optical communication systems, electronic displays, virtual reality glasses etc. Such components makes it possible to replace traditional lenses or prisms with much thinner alternatives. One of the approaches to realize flat optics is by varying the optical axis in a thin film. In this work, a thin layer of chiral (CLC) or nematic liquid crystal (NLC) is used and the optical axis is oriented by photo-alignment with ultra-violet light. A periodically rotating pattern is formed on the glass surface coated with an azo-based photo-alignment material using interference between two circularly polarized beams. Diffraction gratings fabricated using this method are only a few micrometers thick and similar process can be applied to obtain a lens. Since CLC spontaneously forms periodic helical structures, these components are reflective at a certain wavelength range for circularly polarized incident light. Due to this property, optical axis variations on a very small scale are possible without degrading the efficiency. In the case of NLC, highly efficient optical components, diffracting circularly polarized incident light in transmission, can be realized. In this work, simulations of the director configuration and diffraction properties of the components are performed. Then, optical components are realized, including diffraction gratings with period of few micrometer in case of NLC and smaller than 1 micrometer, in case of CLC, allowing efficient diffraction at large angles.

100-word summary for the program:

Miniaturized flat optical components have become essential in all kinds of applications: optical communication systems, electronic displays, virtual reality glasses etc. One of the approaches to realize such components is by varying the optical axis in a thin layer of chiral (CLC) and nematic liquid crystal (NLC) by photo-alignment with ultra-violet light. In this work, simulations of the director configuration and diffraction properties of the components are performed. Optical components are realized, including diffraction gratings with period of a few micrometer, in case of NLC, and smaller than 1 micrometer, in case of CLC, allowing efficient diffraction at large angles.