Surface-controlled Orientational Nonlinearity in LC-Chalcogenide Glass Cell

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We report on the first observation of reversible light-induced changes of the pretilt angle of a nematic liquid crystal (LC) on As_2S_3 chalcogenide glass. Irradiation of a LC cell containing an As_2S_3 film covered glass substrate with a Gaussian beam of a low power cw-laser (wavelength, λ = 0.47 μm, $I < 90$ W/cm^2) leads to a spatially modulated pretilt angle and the corresponding modulation of the phase retardation of the pump and test light beams. The spatial inhomogeneity of LC anchoring results in the formation of a strong nonlinear Gaussian lens in the LC bulk and the appearance of aberration rings in the far field zone. The characteristic rising and relaxation times of the lens formation and decay are of several minutes. To model theoretically the characteristics of the observed lenses we first minimized the total free energy functional subject to the time dependent anchoring. Having found the director spatial profile we studied the light beam propagation through the cell with a spatially modulated pretilt angle and anchoring energy. We determined the focal length and the number of aberration rings depending on the properties of the LC cells. We believe that the observed effect is promising and can be used in recording of dynamic holograms, light-controlled electro-optical devices and lasing.

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