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題目(和文)	オリゴチオフェンドープ液晶の非線形光学効果における入射光の影響
Title(English)	Effect of Incident Light on Nonlinear Optical Response of Oligothiophene-Doped Liquid Crystals
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The purpose of this study is investigation of an effect of incident light properties on molecular reorientation of liquid crystals (LCs). Molecular reorientation of LCs doped with oligothiophene-dye by irradiation with a laser beam has much potential for photonic applications. However, the molecular reorientation has been induced by a confined laser beam like a focused linearly polarized beam, which restricted the various applications. In this thesis, the author investigated the effect of incident light properties on the molecular reorientation of a polymer-stabilized oligothiophene-doped liquid crystals (TR5/PSLCs).

In Chapter 2, the author explored the effect of beam diameter on photoresponsive behavior of TR5/PSLCs. The TR5/PSLC cells were prepared using glass substrates, showing the uniform homeotropic alignment in all cells. The photoinduced molecular reorientation was quantitatively evaluated by self-diffraction ring measurement on the basis of the self-focusing and self-phase modulation using a 488 nm laser beam. As a result, nonlinear molecular reorientation of oligothiophene-doped PSLCs occurred even by the irradiation with a large-diameter collimated beam. The molecular reorientation was along the polarization direction of the pump beam, confirmed by a pump-probe method. In addition, the threshold intensity irradiated with a collimated beam decreased compared to that with a focused beam. This may be due to the decrease in the torque of bulk elasticity by the large-area irradiation with a collimated beam. Furthermore, the molecular reorientation also was caused by irradiation with a patterned polarized collimated beam made by a depolarizer.

In Chapter 3, the author calculated the molecular properties of oligothiophene-dye using a DFT method aiming to reveal the interaction between dye and LC molecules and optical electric field. The molecular properties such as energy levels (HOMO, LUMO), molecular (hyper)polarizabilities (α, β, γ), and UV-vis absorption spectra were calculated for three dyes. In particular, the molecular (hyper)polarizabilities (α, β) of the three dyes were accurate, evident by the agreement with experimental results. However, calculating wavelength dependence of γ, which requires γ at excited states by a 488 nm laser beam, have not been performed.

In Chapter 4, the author examined the elliptical diffraction arising from the molecular reorientation of TR5/PSLCs. The three samples (TR5/PSLCs, TR5/5CB, TR5/A4CB,5CB) were prepared, and their photoresponsive behavior was measured by the self-diffraction ring measurement and pump probe method. The molecular reorientation occurred in all samples due to the photophysical process, in which elliptical diffraction rings were extended perpendicular to the polarization direction of the incident laser beam. The ellipticity was clearly confirmed in TR5/PSLCs, which is attributed to elastic constants of the LC. Moreover, the direct observation of the immobilized irradiated area indicated that the elliptical diffraction is caused by anisotropic molecular reorientation.

In Chapter 5, the author investigated the photoresponsive behavior of TR5/PSLCs by irradiation with circular polarization (CP). The right CP (RCP) and

left CP (LCP) irradiation formed the elliptical diffraction rings, showing the unidirectional molecular reorientation. Moreover, the elliptical diffraction rings were rotated by continuous CP irradiation. The rotating direction of diffraction rings were opposite between RCP and LCP and coincided with the rotation direction of the incident CP. This suggests that the spin angular momentum of the CP causes this rotation.

In Chapter 6, the author summarized the obtained results. In this study, the author irradiated the TR5/PSLCs with various laser beams, resulting in the novel photoresponsive behavior such as elliptical diffraction ring formation. The elliptical diffraction of TR5/PSLCs depends on the polarization state; the LP induced the elliptical diffraction perpendicular to the incident polarization, and the CP induced the rotation of the elliptical diffraction rings. Considering that the number of rings depends on the incident light intensity, these phenomena enable us to visualize the polarization state and light intensity of the incident beam simultaneously. The TR5/PSLCs can be applied to novel functional optical devices such as a polarization visualizer and polarization rotator. For achieving that, the clarification of the precise rotation mechanism and the knowledge how to control the rotation will be needed in future.